ENVIRONMENTAL ASSESSMENT

Integrated Pest Management of Invasive Plants in the City and Borough of Juneau

April 2013

Knotweed infestation on beach-fringe habitat near Thane Road in Juneau

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Acronyms

ADEC, Alaska Department of Environmental Conservation
AM, Adaptive Management
AMPA, Aminomethyl Phosphonate
CBJ, City and Borough of Juneau
CFR, Code of Federal Regulations
CWPPR, Coastal Wetlands Planning, Protection, and Restoration
DM, U.S. Department of the Interior Manual
EA, Environmental Assessment
EIS, Environmental Impact Statement
EPA, Environmental Protection Agency
GPS, Global Positioning System
HACCP, Hazard Analysis and Critical Control Point
IPM, Integrated Pest Management
JCWMA, Juneau Cooperative Weed Management Area
MOE, Margin of Exposure
MSDS, Material Safety Data Sheet
NEPA, National Environmental Policy Act
POEA, Polyethoxylated Tallow Amine
PPE, Personal Protect Equipment
PUP, Pesticide Use Proposal
USDA, United State Department of Agriculture
USFWS, United States Fish and Wildlife Service
USNPS, United States National Park Service

1.0 Introduction

This Environmental Assessment (EA) addresses U.S. Fish and Wildlife Service (Service) supported invasive plant management activities in the City and Borough of Juneau (CBJ) (Figure 1.1). Invasive plants are plant species that are not native to an area and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Due to their aggressive nature, invasive plants have high potential for displacing native plants, disrupting ecosystem functions, and degrading fish and wildlife habitat. Eighty (80) species of non-native plants in more than 5,700 infestations have been documented in the CBJ. Many of these species threaten the integrity and productivity of terrestrial and aquatic ecosystems important to fish, wildlife, humans, and the local economy.

Invasive plants have infested a variety of public and private lands in the CBJ, especially areas where native plant communities have been removed or disturbed by land development and land-use activities, including road and utility right-of-ways, parking lots, yards, and trail corridors. Several species found in Juneau have invaded or are capable of invading relatively pristine or undisturbed habitats such as wetlands, streams, beaches, and riparian areas (Figure 1.2).

The Service's Juneau Fish and Wildlife Field Office (Juneau Field Office) considers invasive plants to be a threat to the conservation and protection of federal trust resources and their habitats in the CBJ. Juneau Field Office participation in invasive plant management activities in the CBJ will facilitate conservation and protection of fish, wildlife, and plant resources as well as maintenance of biological integrity and species diversity. The JFO will support invasive plant management activities in the CBJ as well as promote application of best management practices to reduce new introductions.

The Juneau Field Office is a member of the Juneau Cooperative Weed Management Area (JCWMA), a partnership of citizens and representatives from municipal, state, federal, and tribal organizations concerned about invasive plants in the CBJ. In 2010, the JCWMA published a 5-year invasive plant management plan (available at www.juneauinvasives.org) which established goals and strategies for managing a priority list of invasive plants occurring in the CBJ. Juneau Field Office is helping to implement the plan's strategies by providing technical assistance to the JCWMA. In 2010 and 2011 we provided financial support to the Alaska Association of Conservation Districts to manually control several invasive plant infestations in the CBJ.

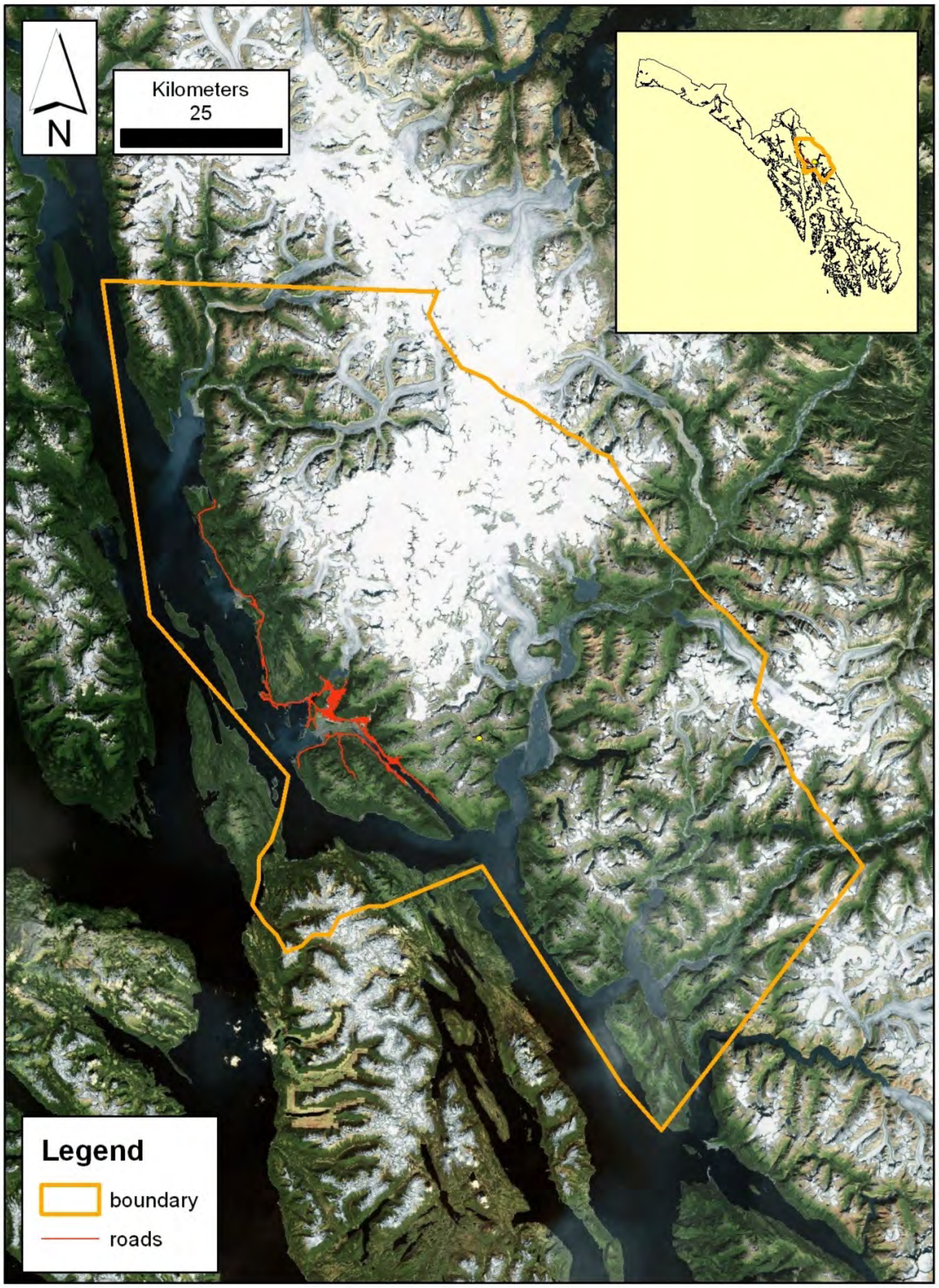

Figure 1.1. CBJ boundary and road system.

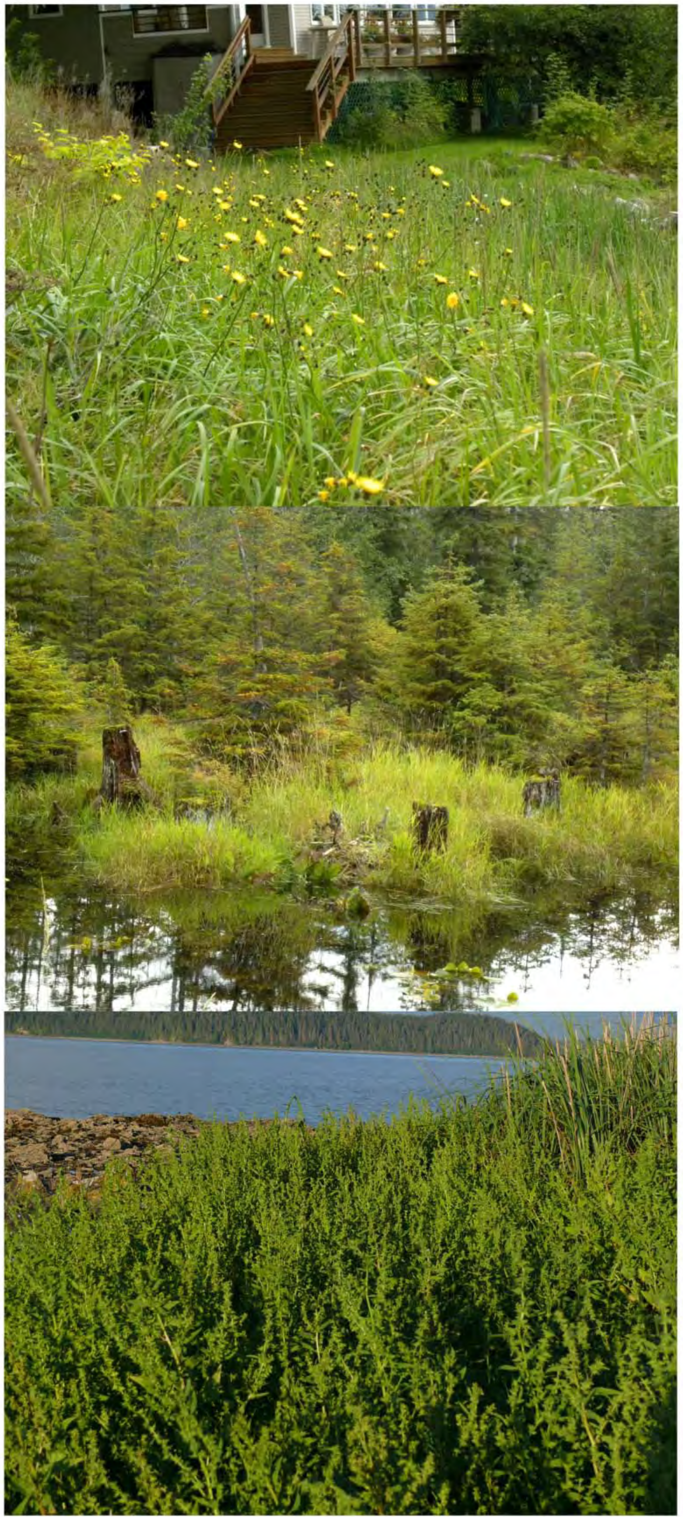

Figure 1.2. Examples of invasive plant infestations in the CBJ: perennial sowthistle in beach fringe (top), reed canarygrass in a wetland (middle), and lambsquarters in beach fringe (bottom).

In this EA, we present two alternatives for future Juneau Field Office-supported invasive plant management within the administrative boundaries of the CBJ. Alternative 1, the no-action alternative, would continue Juneau Field Office-sponsored management of invasive plants. This alternative includes an Integrated Pest Management (IPM) approach that does not allow the use of herbicides. Alternative 2 would adopt an IPM approach and allow judicious use of herbicides in appropriate situations.

IPM is a systematic planning, evaluation, and decision-making process used to guide and direct management of pests such as invasive plant species (USFWS 2004). Specifically, the IPM approach requires evaluation of pest biology, infestation characteristics, environmental factors, and reported effectiveness and environmental impact of various methods of pest management. These methods include cultural (e.g., sanitation practices, burning, mulching), manual (e.g., hand-pulling), mechanical (e.g., mowing), and chemical (e.g., herbicides) techniques which, alone or combined, will minimize potential environmental impacts while also accomplishing the management objectives. We are unaware of any field use of biological agents to control or eradicate invasive plant species in Alaska. Proposed use of biological control methods would require careful consideration of potential benefits vs. risks of the specific proposed biocontrol agent. We therefore do not evaluate use of biological controls within this EA.

The outcome of the IPM evaluation process is a decision on the method, or combination of methods, which would be applied to manage invasive plant infestations. Some infestations may require an adaptive management approach, in which control approaches are implemented, success evaluated, and subsequent control measures are modified based on the outcome of previous efforts.

If adopted, the Juneau Field Office would implement an IPM plan cooperatively with local partners by providing technical and financial assistance to invasive plant management projects in the CBJ. Invasive plant management using herbicides, if selected, would be restricted to the management of a priority list of invasive plant species at specific locations where other management approaches would be ineffective or impractical. Herbicides would be proposed for use only after receiving the consent of the landowner and permitting authorities.

1.1 Purpose and Need for Action

The purposes of this EA are to: (1) present and evaluate two alternative approaches for invasive plant management in the CBJ; (2) propose selection of the alternative that best meets Service policy and Juneau Field Office invasive plant management objectives while minimizing potential environmental impacts; (3) provide an opportunity for public input on planning options; and (4) determine whether the scope and magnitude of impacts expected from implementation of the preferred alternative warrant preparation of an environmental impact statement (EIS). If significant impacts to the human environment are expected, an EIS would be prepared. The Juneau Field Office will select and implement a preferred alternative after evaluating public input and ensuring that significant impacts to the human environment are not predicted. The Service will disclose its final decision and supporting rationale in a separate decision document signed by the Juneau Field Office Supervisor. Our final National Environmental Policy Act (NEPA) determination and related planning documents will be published on the Juneau Fish and Wildlife Field Office's Habitat and Restoration website following public review of this EA and agency consideration of public comments: http://alaska.fws.gov/fisheries/fieldoffice/juneau/restoration.htm

1.2 Background

More than 100 of the nearly 300 non-native plant species recorded in Alaska are considered invasive (Carlson and Shephard 2007, Carlson et al. 2008). Carlson et al. (2008) ranked non-native plant species present in Alaska, as well as species that are likely to be introduced to the state, according to their degree of invasiveness. Invasiveness ranks provide an important means of assessing the potential threat of a species and prioritizing control efforts. A species' rank is based on its known and/or potential impacts on ecosystems, its biological attributes, its geographic distribution, and available control measures. Individual species are scored on a 100-point scale. Species scoring from 60 to 69, 70 to 79, and 80 to 100 are considered moderately-, highly-, and extremely-invasive, respectively. Twenty-four of the 76 invasive plant species found in the CBJ are considered moderately to extremely invasive (Table 1.1). These plant species vary widely in abundance and distribution in the CBJ, from a few plants growing at one or two sites (e.g., white sweet clover, rank = 81) to hundreds of plants per stand, growing in stands at more than 100 sites (e.g., knotweeds, rank = 87).

Table 1.1. Non-native invasive plant species recorded in the CBJ (as of 2011) and their invasiveness ranking[1].

Species	Invasiveness Rank[1]
Bohemian knotweed (*Polygonum X bohemicum*)	87
Japanese knotweed (*Polygonum cuspidatum)*	87
spotted knapweed (*Centaurea stoebe*)	86
reed canarygrass (*Phalaris arundinacea*)	83
ornamental jewelweed (*Impatiens glandulifera*)	82
white sweetclover (*Melilotus alba*)	81
orange hawkweed (*Hieracium aurantiacum*)	79
meadow hawkweed (*Hieracium caespitosum*)	79
cheatgrass (Bromus tectorum)	78
Siberian peashrub (*Caragana arborescens*)	74
European bird cherry (*Prunus padus*)	74
perennial sowthistle (Sonchus arvensis)	73
bird vetch (*Vicia cracca*)	73
rugosa rose (Rosa rugosa)	72
bigleaf lupine (*Lupinus polyphyllus*)	71
garlic mustard (*Alliaria petiolata*)	70
yellow toadflax (*Linaria vulgaris*)	69
yellow sweetclover (Melilotus officinalis)	69
herb Robert (*Geranium robertianum*)	67
Tatarian honeysuckle (*Lonicera tatarica*)	66
tall fescue (*Schedonorus phoenix*)	66
rampion bellflower *(Campanula rapunculoides)*	64
oxeye daisy (*Leucanthemum vulgare*)	61
common tansy (*Tanacetum vulgare*)	60
European mountain ash (*Sorbus aucuparia*)	59
white clover (*Trifolium repens*)	59
quackgrass (*Elymus repens*)	59
common dandelion (*Taraxacum officinale*)	58
alsike clover (*Trifolium hybridum*)	57
bishop's goutweed (*Aegopodium podagraria*)	57
lady's mantle (*Alchemilla mollis*)	56
narrowleaf hawksbeard (*Crepis tectorum*)	56
creeping buttercup (*Ranunculus repens*)	54
timothy (*Phleum pretense)*	54

tall buttercup (*Ranunculus acris*)	54
European forget-me-not (*Myosotis scorpioides*)	54
common chickweed (*Stellaria media*)	54
red clover (*Trifolium pretense*)	53
orchard grass (*Dactylis glomerata*)	53
Siberian wildrye (*Elymus sibiricus*)	53
winter vetch (*Vicia villosa*)	53
Kentucky bluegrass (*Poa pratensis*)	52
perennial ryegrass (*Lolium perenne*)	52
meadow foxtail (*Alopecurus pratensis*)	52
purple foxglove (*Digitalis purpurea*)	51
common sheep sorrel (*Rumex acetosella*)	51
fall dandelion (*Leontodon autumnalis*)	51
black bindweed (*Fallopia convolvulus*)	50
splitlip hempnettle (*Galeopsis bifida*)	50
birdsrape mustard (*Brassica rapa*)	50
brittlestem hempnettle (*Galeopsis tetrahit*)	50
curly dock (*Rumex crispus*)	48
ground ivy (*Glechoma hederacea*)	48
common comfrey (*Symphytum officinale*)	48
scentless false mayweed (*Tripleurospermum inodorum)*	48
black medick (*Medicago lupulina*)	48
Sneezeweed (*Achillea ptarmica*)	46
annual bluegrass (Poa annua)	46
prostrate knotweed (*Polygonum aviculare*)	45
common plantain (*Plantago major*)	44
hairy catsear (*Hypochaeris radicata*)	44
common chickweed (*Stellaria media*)	42
common eyebright (*Euphrasia nemorosa*)	42
Italian ryegrass (*Lolium multiflorum*)	41
dame’s rocket (*Hesperis matronalis)*	40
shepard’s purse (*Capsella bursa-pastoris*)	40
common hempnettle (*Galeopsis tetrahit*)	40
Canada bluegrass (*Poa compressa*)	39
lambsquarters (*Chenopodium album*)	37
common groundsel (*Senecio vulgaris*)	36
big chickweed (*Cerastium fontanum*)	36
thymeleaf speedwell (*Veronica serpyllifolia*)	36

nipplewort (*Lapsana communis*)	33
red sandspurry (*Spergularia rubra*)	33
disc mayweed (*Matricaria discoidea*)	32
corn spurry (*Spergula arvensis*)	32

[1]Ranking derived the Alaska Exotic Plant Information Clearinghouse database (AKEPIC 2012) Depicted ranking classes include: extremely invasive (>80), highly invasive (70-79); and moderately invasive (60-69); modestly invasive (50-59); weakly invasive (40-49); very weekly invasive (<40).

Over the past 10 years, invasive plant management activities in the CBJ have focused primarily on inventories of species distributions, with control efforts limited to the evaluation of different eradication techniques on high priority species. Since the establishment of the JCWMA in 2010, invasive plant management in the CBJ is focused on public education, management prioritization, and on-the-ground control of high priority species. These efforts have included several outreach and education activities highlighting the impacts and threats of invasive plants within the CBJ. Methods include hand-pulling individual plants (e.g., perennial sowthistle, oxeye daisy), placing tarps over infestations (e.g., Bohemian and Japanese knotweed), and herbicide treatments (e.g., orange hawkweed, Bohemian knotweed, and garlic mustard). Although many of the above projects have been successful, the current level of effort is not considered sufficient to reverse the expansion of existing invasive plant infestations or limit their spread to new habitats.

Glyphosate is the most commonly used herbicide used to control invasive plants in the CBJ. Since 2006, glyphosate has been applied to a large garlic mustard infestation on private lands near downtown Juneau. Glyphosate is also used to control knotweed. Private landowners and certified pesticide applicators apply liquid formulations into the hollows of cut knotweed stems, or use backpack sprayers to spray it on plants. In 2008 and 2009, the U.S. Forest Service Juneau Ranger District annually injected glyphosate into knotweed stems at their Auke Bay Recreation Area. In the summer of 2010 and 2011, Invasive Plant Coordinators from the Alaska Association of Conservation Districts injected glyphosate herbicide into knotweed stems at several sites on private and CBJ properties.

The Service proposes to utilize an IPM approach when managing invasive plants, potentially including the judicious use of herbicides when necessary. We approach the use of herbicides with caution. Our IPM approach would evaluate all potential control methods and balance efficacy with environmental impact. Before herbicide use can be initiated, Service policy requires preparation and approval of a Pesticide Use Proposal (PUP) (Service Manual Chapter 569 FW 1, Integrated Pest Management). These PUPs describe the pest-, site-, and chemical-specific proposal for review and authorization by the appropriate agency specialist (e.g., in the Alaska Region an Environmental Contaminants Specialist and/or Integrated Pest Management Coordinator [IPM Coordinator]). Refer to Appendix A for more general information on the PUP process.

Should herbicides be used, Service applicators and/or our cooperators must follow all requirements on the pesticide label, including prescribed application rates and techniques, public notification and re-entry requirements, pesticide mixing and storage best management practices, and practices that protect applicator health and safety. Any herbicide use by Service staff, seasonal workers or volunteers would conform to requirements of Service Manual Chapter 242 FW 7, Pesticide Users Safety (FWS 2009a). While not always required by the pesticide label, projects funded by the Juneau Field Office will require supervision of all chemical applications by a pesticide applicator that has been certified by the State of Alaska.

1.3 Legal Authorities

The Service is required by law and policy to protect and conserve fishes, wildlife, and plants while also ensuring that biological integrity, diversity, and environmental health are maintained. The following section summarizes the legal framework for management of invasive plants in the CBJ by the Juneau Field Office.

Executive Order 13112 (1999) defines an invasive species as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.” In the Executive Summary of the National Invasive Species Management Plan, the term invasive species is further clarified and defined as “a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.” The Executive Order defines pests as “(1) Any insect, rodent, nematode, fungus, weed, or (2) any other form of terrestrial or aquatic plant or animal life or virus, bacteria, or other microorganism (except viruses, bacteria, or other microorganisms on or in living man or other living animals) which the [Environmental Protection Agency] Administrator declares to be a pest under section 136w (c)(1) of this title [FIFRA, 7 U.S.C. 136(t)].” Throughout the remainder of this EA the terms pest and invasive species are used interchangeably. This Executive Order requires that each *“Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law,*

> *(1) identify such actions;*

> *(2) subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them"*

Pest control is authorized by the U.S. Department of the Interior's (DOI) Integrated Pest Management policy (517 DM 1) (DOI 2007), where "DM" denotes "U.S. Department of the Interior Manual". Under this Departmental policy, pests are defined as *"…living organisms that may interfere with the site-specific purposes, operations, or management objectives or that jeopardize human health or safety."*

In accordance with Service policy (Service Manual Chapter 569 FW 1 Integrated Pest Management [FWS 2010]), we manage pests if:

> "*A. The pest causes a threat to human or wildlife health or private property; action thresholds for the pest are exceeded; or Federal, State, or local governments designate the pest as noxious;*
>
> *B. The pest is detrimental to site management goals and objectives; and*
>
> *C. The planned pest management actions will not interfere with achieving site management goals and objectives."*

Invasive plant management activities in the CBJ would be funded primarily through the Juneau Field Office's Partners for Fish and Wildlife (Partners) and Coastal Conservation (Coastal) Programs. The Juneau Field Office would also partner with other organizations to manage invasive plants with funds obtained from private, state, or other federal sources. The Partners Program is the Juneau Field Office's primary mechanism for delivering voluntary on-the-ground habitat improvement projects on private lands for the benefit of Federal trust species (e.g., migratory birds and Pacific salmon). The program provides technical and financial assistance to landowners to help meet the habitat needs of Federal trust species on private lands. The term "habitat improvement" includes habitat restoration, enhancement, and establishment. Chapter 640 FW 1 of the Service Manual prescribes policies and procedures for implementation of the Partners Program. The authorities for this chapter include:

- Fish and Wildlife Coordination Act (16 U.S.C. 661).
- Fish and Wildlife Act of 1956 (16 U.S.C. 742a-j).
- Partnerships for Wildlife Act (16 U.S.C. 3741).

Section 1.8 of this chapter discusses policies and procedures relevant to invasive plant management activities. These include:

- The Partners program "*…undertake[s] habitat improvement practices to restore or artificially provide physiographic, hydrological, or disturbance conditions necessary to establish or maintain native plant and animal communities.*"
- Habitat restoration is defined as "*…the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning full (natural/historic) functions to lost or degraded native habitat.*"
- Habitat restoration practices are "*…conducted with the goal of returning a site, to the extent practicable, to the ecological condition that likely existed prior to loss or degradation." Examples include "…burning grass communities heavily invaded by exotic species to reestablish native grass/plant communities; and planting native plant communities that likely existed previously on the site.*"
  The Partners Program guidance also emphasizes that when pesticides are used during habitat management, we will follow applicable Service policies, including "development and review of a pesticide use proposal."
    - The mission of the Coastal Program is to conserve healthy coastal ecosystems for the benefit of fish, wildlife, and people. This mission is accomplished through cooperative partnerships that identify, restore, and protect habitat in priority coastal areas. Program authorizations include sections 302, 305, and 306 of the Coastal Wetlands Planning, Protection and Restoration (CWPPR) Act of 1991, 16 U.S.C. 3954. Section 305 provides that the Director of the U.S. Fish and Wildlife Service *". . . make matching grants to any coastal State to carry out coastal wetlands conservation projects . . ."* Chapter 521 FW 3 (FWS 2000) of the Service manual provides eligibility standards and administrative procedures for the Coastal Program. Standards and procedures that are relevant to invasive plant management activities include "*Restoration, enhancement, or management of coastal wetlands ecosystems. Management, in the context of this chapter, means habitat management only. Habitat management includes vegetation manipulation and restoration of habitat to support fish and wildlife populations*."

Consistent with Service's Ecosystem Approach policy 052 FW 1 (FWS 1996), which mandates that the Service conserve, protect and enhance fish and wildlife and their habitats for the continuing benefit of the American people. This policy directs the Service to perpetuate natural communities of plants and animals, maintain naturally occurring biological and genetic diversity, protect rare and ecologically important species, minimize habitat fragmentation, and control undesirable exotic species. Pest management activities that will enhance our ability to meet these management goals include: (1) prevent introduction of non-native plants and minimize the impact of existing infestations via control or removal, and (2) adopt control or removal practices that prevent or minimize collateral adverse effects to the environment, subsistence use opportunity, water quality, and human health.

As directed by the Service’s Ecosystem Approach policy (052 FW 1) and its National Strategy for Management of Invasive Species (USFWS 2004), the Juneau Field Office will work in partnership with public agencies, private organizations, landowners, and citizens to control and where feasible eliminate invasive plant species and improve and maintain healthy ecosystems on CBJ lands, regardless of ownership or jurisdiction. Attainment of this goal requires cooperative education, prevention, and control actions. Without action, invasive plants will continue to spread to suitable habitat and further compromise ecosystem integrity.

As described above, the Service proposes to utilize an IPM approach when managing invasive plants, potentially including the use of herbicides when necessary. In general, our approach would include: a requirement to consider all potential control methodologies and apply an IPM approach to evaluate the efficacy and environmental impact of different management methods. Before herbicide use can be initiated, Service policy requires preparation and approval of a Pesticide Use Proposal (PUP). These PUPs describe the pest-, site-, and chemical-specific proposal for review and authorization by the appropriate agency specialist (e.g., IPM Coordinator in the Alaska Regional Office, or in some cases at the national headquarters office) and the Field Office Supervisor. Refer to Appendix A for more information on the PUP process.

The Juneau Field Office will use IPM plans to fully evaluate and describe available control options for invasive plant management in the CBJ. These plans require authorization of the Regional IPM Coordinator and Field Office Supervisor before they can be implemented.

Should herbicides be used, applicators must follow all requirements of the pesticide label, including prescribed application rates and techniques, public re-entry requirements, pesticide mixing and storage, and applicator protection standards such as use of personal protective clothing. While not always required by the pesticide label, the Service encourages that all chemical applications be supervised by a pesticide applicator that has been certified by the State.

1.4 Issues

When preparing this EA, the Juneau Field Office solicited public input on methods we might use to manage invasive plants (refer to Appendix B for a copy of the solicitation letter). A single response was received from the State of Alaska Department of Environmental Conservation (ADEC), Division of Water. ADEC expressed concerns about the potential impact of invasive plant management activities on aquatic habitat and water quality. Potential impacts to aquatic resources and water quality are evaluated later in the EA. The Juneau Field Office will work with state and federal regulatory agencies to ensure that management activities conform to applicable regulations designed to protect water resources. Additionally, this EA will address common issues surrounding the use of herbicides to manage invasive plants, including potential for ecological effects and possible effects on human health.

2.0 Alternatives

In this section, we describe the two alternatives for Service-funded, cooperative management of invasive plants in the CBJ. Implementation of each alternative would entail application of an IPM approach. However, only one alternative would allow for herbicide use. Common elements shared by the alternatives are highlighted separately. Refer to Table 2.2 at the end of this chapter for a comparison of summarized characteristics of the alternatives. Under either alternative, the Juneau Field Office may choose not to direct any time, personnel, or funding resources to support invasive plant management actions depending on the availability of funds and program priorities.

2.1 Elements Common to Alternative 1 and Alternative 2

Effectiveness of invasive plant management is determined by two primary factors: public awareness of invasive species and effective monitoring strategies. Public awareness is required to prevent continued spread of existing invasive species, as well as establishment of additional invasive species in the CBJ. Monitoring the distribution and abundance of invasive plants is essential for implementing an effective IPM plan in collaboration with landowners and other partners.

Under both alternatives, Juneau Field Office would continue to participate in the JCWMA to increase public awareness and to monitor the status and trends of invasive plants and the means by which they spread. Below we describe primary elements of outreach and monitoring.

2.1.1 Outreach

Outreach would have three primary purposes: to increase public awareness of invasive plants, to discourage deliberate or inadvertent establishment of invasive plants, and to facilitate management of known infestations of priority invasive plants.

Service IPM policy (569 FW 1) (FWS 2010) promotes pest prevention as the first line of defense by using pathway management strategies such as Hazard Analysis and Critical Control Point (HACCP; see 750 FW 1 [FWS 2009b] for more details) planning to prevent unintended spread of species.

In coordination with the JCWMA and other partners, Juneau Field Office would provide financial and technical support for developing and distributing information on the identification, ecology, and management of invasive plants and the prevention of new introductions. Specific support would include:

- Public presentations (e.g., public event information booths, slideshows);
- Creation and distribution of outreach materials (e.g., brochures, posters) to educate the public, land managers, and others about the impacts of invasive plants and their management;
- Meeting with the general public, landowners, and agency officials to provide information about invasive plants and their management; and
- Supporting management of invasive plant species with the highest potential to adversely impact native plant communities, Service trust resources, ecosystem services, and dependent human uses (Table 1.1).

Working within the JCWMA, prevention of new infestations would be a major area of emphasis for the Juneau Field Office. Prevention is the most cost effective way to minimize future introductions, a key goal of any long-term management strategy, and a cornerstone of Service IPM policy. Juneau Field Office would support outreach efforts and sanitation practices that would prevent inadvertent off-site transportation of invasive plants.

2.1.2 Inventory and Monitoring

Invasive plant inventories are necessary to determine the occurrence, identity, and distribution of invasive plants in the CBJ. The purposes of monitoring would be: (1) document changes in invasive plant population size and locations and (2) monitor ecological response to management actions of species considered moderately to extremely invasive (Table 1.1).

Invasive species of greatest concern to the Juneau Field Office are those species (hereafter referred to as priority species) with invasiveness rank scores of 60 and higher (AKEPIC 2012). Certain invasive plant species with rank scores below 60 would be managed where they are aggressively invading undisturbed habitats, critical wildlife habitat, or notably diverse, productive, or rare habitats and ecological communities. As new invasive plant species are discovered in the CBJ, additional species meeting the criteria above will be added to Table 1.1.

Juneau Field Office would work cooperatively with the JCWMA and the Alaska Natural Heritage Program at the University of Alaska Anchorage to update existing invasive plant inventories, including the AKEPIC database (AKEPIC 2012). The scope of the Juneau Field Office's inventory effort would focus on developed areas within the CBJ that are adjacent to important fish and wildlife habitat and other sensitive habitats and ecosystems. These areas include lands in private, corporate, state, and federal ownership. The Juneau Field Office would work cooperatively with these landowners to inventory and support management of invasive plants.

Inventory work would primarily target sites of existing and historic human development and use. We would request written permission of the landowner to access and inventory private lands within the CBJ. Data collected during field visits would include occurrence, identity, and geographic extent of invasive plants, accompanied by photos. Data acquired from inventories would be catalogued in databases managed by the Juneau Field Office and JCWMA. The Juneau Field Office would annually submit this information to the Alaska Exotic Plants Information Clearing House http://akweeds.uaa.alaska.edu/. Inventory data and reports would be available from the JCWMA web site.

2.1.3 Adaptive Management

In accordance with Departmental policy, 522 DM 1 (Adaptive Management Implementation) (DOI 2008), the Juneau Field Office shall utilize adaptive management (AM) for conserving, protecting, and, where appropriate, restoring lands and resources. Within federal regulations (43 CFR 46.30), AM is defined as a system of management practices based upon clearly identified outcomes, where monitoring evaluates whether management actions are achieving desired results (objectives). The *DOI Adaptive Management Technical Guide (Williams et al 2009)* also defines AM as a decision process that "promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood". An AM approach accounts for the concern that complete knowledge about fish, wildlife, plants, habitats, and the ecological processes supporting them may be lacking. The role of natural variability contributing to ecological resilience also is recognized as an important principle for AM. It is not a “trial and error” process, but rather AM emphasizes learning while doing based upon available scientific information and best professional judgment considering site-specific biotic and abiotic factors on lands within the CBJ.

2.2 Alternative 1: An IPM Approach without Herbicide Use

Under this alternative, infestations of invasive plant species could be actively managed using an IPM approach which would exclude the use of herbicides. The following criteria would be applied to establish priorities for infestation management. Our first priority when allocating scarce resources would be to address infestations impacting high quality habitat, then species with a high ability of dispersal, then species impacting moderate quality habitat and/or with a moderate ability of dispersal. Public outreach and education and invasive plant inventorying and monitoring will be important components of invasive plant management under this alternative.

Management of an infestation would always take place in cooperation with landowners. The purposes of this cooperation would be: (1) to advocate for the use of an IPM approach to manage documented infestations of priority invasive plant species, and (2) to provide technical assistance and funding to the landowner or a third party cooperator, as requested, including advice on management options; demonstration of management methods; and participation in management actions at the request of the landowner. Service funding sources which could be used to help landowners and partners address weed management issues could include, but might not be limited to, the Service’s Coastal Conservation, Partners for Fish and Wildlife, and Tribal Wildlife Grant programs, Wildlife Restoration grants and Sport Fish Restoration grants.

Consistent with Service (FWS 2010) and Departmental (DOI 2007) policy an IPM approach would be applied under Alternative 1 that considers a range of available tools and techniques to manage invasive plants. This policy also encourages, but does not require, completion of IPM Plans to document the pest management evaluation and decision process. This EA provides a sound basis for any future IPM planning activities. IPM plans under Alternative 1 would exclude chemical methods of management while maximizing use of non-chemical methods of management in an attempt to contain, or where possible eradicate priority species.

IPM methods described below summarize the primary non-chemical methods that would be applied to manage priority invasive species. The use of these various techniques would depend upon the biology of the target plants, physical characteristics of the site, the remoteness of the site, and the habitat management goals established by the Juneau Field Office and its partners.

Cultural Control and Prevention. Cultural methods typically involve manipulation of the habitat to make it less suitable to the pest and preventative measures to reduce or prevent the introduction or spread of a species.

Juneau Field Office staff and cooperators and their contractors would be required to inspect equipment and personnel for invasive plant parts or seed and to clean, and dispose of these as appropriate. We will consider the HAACP process (i.e., FWS 2009b) as a potential model when developing a prevention approach. Following conclusion of invasive plant management actions, we would clean equipment used in the operations.

Other examples of cultural control practices that may be appropriate for certain situations in the CBJ include mulching, flaming, and burning. While natural re-vegetation can often effectively re-establish native plant communities in treated areas, active re-vegetation with native plants would be emphasized to prevent erosion and re-infestation by invasive plants and to accelerate the habitat recovery process.

Manual control. Manual control methods involve removing invasive plants by hand or through the use of hand tools. Location of infestation sites of targeted invasive species would be recorded with a Global Positioning System (GPS) device. Standing dead vegetation would be manually cleared to expose all spring growth of perennial invasive herbs (i.e., forbs and grasses) at each site. The perimeter of each infestation site would be marked with biodegradable flagging. Field workers would use various digging and cutting hand-tools, such as shovels, spades, trowels, pick-mattocks, and dandelion diggers to remove roots of invasive perennial plants. Native plants and topsoil would be removed as needed to facilitate access to roots of invasive plants. Removed invasive plants would be double bagged and buried in the CBJ landfill. Following treatment, topsoil and remaining native plants would be replaced to the extent feasible and any remaining exposed soil seeded or planted with native species. Follow-up visits would be made to infestation sites during summer to gauge success and to remove, bag, and dispose or bury the flowers of surviving invasive plants to prevent production of seed. Because this activity itself involves a risk of spreading the invasive plant (e.g., seeds or plant parts attached to boots, laces, gloves, etc.), prevention measures would be addressed in an IPM plan that incorporates HACCP concepts to identify risk reduction strategies.

Mechanical and other physical controls. Mowing is one type of mechanical control that could be used to minimize flowering and seed spread of invasive perennial herbs for sites where mowing is practicable. Repeated mowing can also reduce plants vigor in some species. Cutting with a chainsaw could remove above-ground growth of large invasive shrubs and trees. However, mowing and cutting are generally considered ineffective for perennial invasive herbs that also propagate vegetatively from rhizomes or stolons. Because this activity also involves a risk of spreading an invasive plant (e.g., seeds or plant parts attached to a mower undercarriage or chainsaw blade or casing, etc.), prevention measures would be addressed in an IPM and/or HAACP plan to identify best management practices that reduce these threats. The placement of landscaping cloth or tarps over infestations is an effective but non-selective physical control method for killing certain invasive plants in the CBJ (e.g., knotweeds, orange hawkweed). This technique kills plants by physically preventing their growth and by blocking sunlight.

2.3 Alternative 2: An IPM Approach with Herbicide Use *(preferred alternative)*

Under this alternative, documented infestations of priority invasive plant species could be actively managed with an IPM approach, using a suite of preventative, cultural, mechanical and/or manual methods as described in Alternative 1. Under this alternative, targeted herbicide use would be allowed when necessary to achieve site management goals, with landowner permission and in compliance with all applicable Service and Departmental policies, federal laws and regulations, and strict adherence to all pesticide label conditions. The same criteria would be applied to determine priority and scope of infestation management as described in Alternative 1. As with Alternative 1, public outreach and education, preventing new introductions, and invasive plant inventorying and monitoring will be important components of invasive plant management under this alternative.

We currently propose limiting the use of herbicides to those with the active ingredients aminopyralid or glyphosate (Table 2.1) that are registered for use by the EPA and the State of Alaska. Either of these could be used following assessment of infestation site characteristics, target species life history characteristics, an IPM evaluation of potential site- or habitat-specific control techniques, and agency review and authorization of site- and herbicide-specific PUPs. In the field, two adjuvants, a non-ionic surfactant and if necessary a colorant would be added to the tank mix containing herbicide and water. Adjuvants enhance the performance and efficacy of the herbicide (Tu et al. 2001).

In all cases where Juneau Field Office personnel conduct herbicide application, or where Service funds specifically support herbicide application by others including contractors and cooperators (e.g., via the Coastal, Partners for Fish and Wildlife, or Tribal Wildlife Grant Programs, Wildlife and Sport Fish Restoration grants, or other similar funding mechanisms), a chemical-specific PUP would be prepared, thoroughly reviewed by the Service's Integrated Pest Management Coordinator, and approved (with or without modifications) prior to herbicide use.

We would employ an action threshold when considering management of invasive plants with herbicides. We would manage invasive plants with non-herbicide methods where an infestation consisted of 10 or fewer invasive plants per infestation area. An infestation area is defined as a relatively small and geographically distinctive place with one or more invasive plants or separated groups (populations) of invasive plants collectively encompassed within a distinct geographic area. For example, an infestation area may consist of a single place with an isolated population of three orange hawkweed plants. However, an infestation area also may consist of 50 or more populations—each a single infestation—of hawkweed plants collectively distributed within a geographically distinct area with similar site conditions such as rainfall and soil type.

Table 2.1. Proposed herbicides and their characteristics.

Active Ingredient (Formulated Product)	Target Species - Examples	Mode of Action	Method of Application
Aminopyralid (e,g.,Milestone™VM)	Orange hawkweed, oxeye daisy, creeping buttercup, tall buttercup, common tansy, splitlip hempnettle	Disturbs plant growth and is absorbed by green bark, leaves and roots, and moves throughout the plant. Accumulates in the meristem (growth region) of plant.	Ground-based spot spraying with a manually operated backpack sprayer. Best management practices include wind restrictions, use of low-pressure, coarse spray to reduce drift potential, spraying with a low wand height to reduce drift.
Glyphosate (e.g., Aquamaster®)	Reed canarygrass, Bohemian and Japanese knotweed, cheatgrass, creeping and tall buttercup, garlic mustard, ornamental jewelweed, perennial sowthistle	Absorbed by leaves and rapidly assimilated into plant tissue. Prevents plant from producing an amino acid essential to growth and survival.	Ground-based spot spraying with a manually operated backpack sprayer, as above. Also wiping of herbicide on cut shrub or tree stems, or injection into shrub stems.

Herbicides could be selectively applied where the number of invasive plants did not exceed 10 individuals per infestation area when:

- Cultural, manual and/or mechanical means were deemed infeasible via a review of the technical literature and/or past experience of other IPM practitioners; or
- Cultural, manual and/or mechanical methods were attempted but failed to eliminate the invasive plant infestation

Chemical treatment methods would be used in conjunction with selected cultural, manual and mechanical practices as appropriate. The method of herbicide application would depend on the target species, site characteristics, and infestation size. Selection of the specific application method would be based on evaluation of species life history characteristics and review of techniques that other IPM practitioners have found to be effective with a particular species. The direct foliar application method would involve a conventional backpack sprayer fitted with small (e.g., four-gallon) tank, manually-activated pressure pump, and single or multi-nozzle spray applicator. The cut-stem method would involve painting herbicide on to cut stems or stumps of priority invasive shrub or tree species. The foliar wipe method would involve wiping herbicide onto foliage. The injection method would involve use of a specially designed syringe to inject herbicide into the base of an invasive shrub stem. Aerial application of herbicides would not be authorized under the provisions of this EA, and the potential effects of aerial application scenarios are therefore not analyzed.

Before field deployment each year, herbicide application equipment would be tested for functional condition and calibrated to achieve the appropriate application rate. In backpack sprayers, for example, application rate is typically determined by species-specific volumes or application rates listed on the herbicide label. Operationally, the application rate is achieved through a combination of tank pressure level, walking speed, and spray droplet size. Proper calibration will be ensured via the standard method of filling a tank with one gallon of water, pumping the handle to maximum pressure (e.g., 15 psi), holding the applicator wand near the ground, moving it back and forth, spraying water, maintaining pump pressure until the water is expended, and computing the area sprayed. The calibration of application equipment will also be verified periodically during the field season, to ensure consistent delivery of herbicides that conform to labeled application rates.

Juneau Field Office staff, contractors, or partners certified as pesticide applicators by the Alaska Department of Environmental Conservation would be responsible for training of staff and cooperators involved with herbicide applications, and certified applicators would supervise all herbicide applications. Training would include review of herbicide product label specifications for herbicide use, review of the MSDS for the herbicide and adjuvant products, application objectives and conditions, best management practices to ensure on-target delivery of herbicides with minimal drift, applicator safety requirements, legal requirements (such as application rates set by the pesticide label), spill prevention/response procedures, and proper equipment use, including calibration.

Infestation sites targeted for application of herbicide would be visited before the application to prepare them for herbicide treatment. A combination of preparation practices may be employed depending on the species targeted for control and the stage of plant growth. Pre-treatment preparations could include manually clearing standing vegetation, manually removing flowers, flagging the perimeters of infestation sites, or mowing the site. Such preparation can prevent seed dissemination, increase the visibility of invasive plants to herbicide applicators, decrease the amount of herbicide applied, and minimize the exposure of non-target plants to herbicide.

Consistent with Alaska Pesticide Control Regulations (18 AAC 90.630), areas considered “public” would be posted before herbicide application with a temporary closure notification. We also intend to post signage at all treatment sites, regardless of whether they meet the specific definitions of a “public” place as defined in State regulations. Re-entry periods specified on the label would serve as the minimum closure period for treatment areas. Posting periods could be extended at the discretion of the Juneau Field Supervisor and we may elect to close areas and post signage for longer time periods. Information on this notification would include the application date, duration of closure, name of the commercial herbicide product, and EPA registration number. Once the project site was appropriately prepared and public notice was issued regarding the plan for herbicide application, we would commence the application phase of a project.

Personnel involved in the application would be required to wear personal protective equipment (PPE) during herbicide application as stipulated in the herbicide product label, IPM Plan, and/or approved PUP conditions. Fish and Wildlife Service staff, contractors, and partners would meet or exceed label PPE requirements.

Materials and supplies needed for the application would be transported to a designated upland mixing site that is at least 50 feet from water bodies. Other mixing/loading best management practices would include use of impervious tarps and/or other containment equipment that would prevent migration of spilled material to the soil, and a requirement that spill response materials such as sorbent pads be available at the mixing site. For projects undertaken by partners, rather than the Service itself, these types of stipulations would be specified in grant agreements and/or supporting materials.

For backpack spraying treatments, the herbicide (aminopyralid or glyphosate formulated product), a low toxicity surfactant, and if necessary a colorant would be measured and sequentially mixed with water in the tank in accordance with the herbicide product label. Following mixing, personnel would don the backpack sprayers, walk to the infestation site, and proceed with application by targeting and spraying individual priority invasive plants. Applicators would be instructed to minimize spraying of non-target plants, to the extent possible. Following herbicide application, equipment would be thoroughly cleaned. In most cases, treatment success would be evaluated the following year before additional treatment occurred.

Characteristics of Proposed Herbicides and Surfactants

<u>Aminopyralid</u>

Aminopyralid (Milestone*TM*VM) is a relatively selective systemic herbicide developed for the control of broadleaf weeds in rangeland, non-crop areas and grazed areas, and some agricultural uses. Aminopyralid controls many broadleaf species in the families' Asteraceae, Fabaceae, and Solanaceae, however, it cannot control some broadleaf species such as leafy spurge, Dalmatian toadflax, and a few others (Enloe et al., 2007). aminopyralid has been found to be very effective against some invasive plants that are common invaders in Alaska. For example, mechanical control methods have proven ineffective in controlling orange hawkweed, while low application rates of aminopyralid have proven very effective against this invader at test plots in Alaska (Seefeldt and Conn 2011).

Aminopyralid received a “reduced risk” designation when it was registered by the Environmental Protection Agency (EPA), due to its favorable toxicological profile, ecotoxicological, and environmental fate profile, in combination with unique and improved features for invasive weed control (Jachetta et al. 2005, EPA 2005). An advantage of aminopyralid is that it is effective in controlling a number of invasive plants at application rates that are much lower than alternatives such as picloram, dicamba, 2,4-D and clopyralid (e.g., DiTomaso and Kyser 2006, Enloe et al. 2007, Enloe et al. 2008).

The scope of any future aminopyralid applications by the Service and/or our partners would be limited to terrestrial uplands. The Milestone*TM*VM label allows treatment of non-irrigation ditch banks, seasonally dry wetlands (including flood plains, deltas, marshes, swamps and bogs) and transitional areas between upland and lowland areas.

The Milestone™VM label also states that it can be used up to the water's edge, however it cannot be applied directly to water.

<u>Glyphosate</u>

Glyphosate is a broad-spectrum, non-selective, post-emergence systemic herbicide controlling a wide range of annual and perennial species including both broadleaf plants and grasses. While a specific glyphosate brand or product will not be identified within this EA (as different products and brand names are periodically added or removed from the market), only commercial formulations registered for use by the EPA and the State of Alaska in both upland and aquatic environments could be used. Currently Aquamaster® is one example of a glyphosate-based herbicide that is registered in Alaska and which meets these performance criteria.

A recent risk assessment prepared for the US Forest Service (SERA 2011) classifies these aquatic/upland glyphosate formulations (such as Rodeo, Accord, Aquamaster, AquaNeat and Glypro) as Low Toxicity/High Confidence formulations (i.e., there is enough data to determine with high confidence that these are low toxicity formulations). The SERA (2011) risk assessment evaluates and contrasts these Low Toxicity formulations with other formulations containing various proprietary surfactant compounds. Many glyphosate formulations include surfactants and the toxicity of these surfactants is potentially of equal or greater concern during the risk assessment than the toxicity of technical grade glyphosate. Of particular concern are a group of surfactants that contain polyoxyethyleneamine (POEA) compounds (SERA 2011). These distinctions will be discussed in more detail in section 4.2.9 of the EA.

<u>Surfactants</u>

The Milestone™VM label recommends use of a non-ionic surfactant to enhance product effectiveness and the Aquamaster label requires use of a non-ionic surfactant. Non-ionic surfactants, including AGRI-DEX® (discussed below) can increase the efficacy of herbicides such as glyphosate, and use of surfactants can reduce the amount of herbicide required to control targeted plants (Singh and Sharma 2001). Only the least toxic of non-ionic surfactants (e.g., EPA acute toxicity rating of "practically non-toxic" with an acute LC50 > 100 mg/L) would be used to increase performance and efficacy of aminopyralid and glyphosate. Toxicity would be assessed using available technical reports, peer-reviewed journal articles, Material Safety Data Sheets (MSDS), comparative literature reviews, and similar sources. Initially, chemical treatments would use the surfactant AGRI-DEX® which has much lower aquatic toxicity than most, if not all, comparable products (Monheit et al. 2004, Smith et al. 2004). Alternative surfactants could be considered in the future if they are effective and exhibit low toxicity (e.g., comparable to or lower toxicity than AGRI-DEX® and/or with an acute LC50 > 100 mg/L). AGRI-DEX® is currently approved for use in Washington State waters (WDOE 2012) and is one of only four adjuvants approved for use in Michigan waters (MDEQ 2012).

Table 2.2. Comparison of the action alternatives for managing invasive plants in the CBJ.

Category	**Alternative 1: IPM without herbicide**	**Alternative 2: IPM with herbicide**
Geographic scope	Infestations on federal, state, and private lands within the CBJ.	Same as Alt. 1
Invasive species	Currently includes 24 moderately to extremely invasive species in the CBJ and any other species that currently or in the future present an elevated risk to fish and wildlife and their habitats.	Same as Alt. 1
Control methods	Exclusively cultural, manual and/or mechanical.	Cultural, manual, mechanical, and/or chemical. Chemical herbicide use limited to areas where density of invasive plants exceeds an action threshold of 10 plants per infestation area and/or target species biology indicates it cannot be controlled successfully using non-chemical methods.
Herbicides	None.	Active ingredients: aminopyralid (e.g., Milestone™VM) or glyphosate (e.g., Aquamaster®).
Acres treated	Number of acres treated are expected to increase to an undefined upper limit determined by limits of funding and cooperator/partner capacity. Small infestations may be successfully eliminated; some large infestations may not be eliminated due to lack of resources. Non-chemical methods may not be effective for some intractable invasive plant species, resulting in increased populations for those species.	Number of acres treated initially increase as with Alternative 1. As more areas are treated, managed acres will decline as infestations are successfully controlled and/or eradicated.
Human health	Potential hazards readily predicted, observed, and controlled. Cumulative impact negligible and temporary.	Potential hazards associated with manual and mechanical methods readily predicted and controlled. Potential hazards associated with chemical methods are evaluated using available literature and risk assessments. Potential hazards are controlled via use of products with low mammalian toxicity, low risk to the public, best management practices for herbicide mixing and application, use of PPE that meets or exceeds label requirements and compliance with applicable regulatory, agency, and product standards for safe use. Cumulative impact negligible and temporary.
Ecological effects	Negligible short-term impact associated with management of small infestations. Locally major impacts associated with management of large infestations due to substantial disturbance associated with removal of topsoil and non-target plants during removal of invasive plants including all root matter. Long-term cumulative impact increases from minor to moderate due to	Minor short-term impact associated with reduction in plant cover protecting soil, injury and/or mortality to non-target plants, and reduction in wildlife cover due to herbicide use and non-chemical control measures. Potential impacts to aquatic resources including salmonids were considered and determined to be minor or negligible. Impacts expected to decrease as the size of the infestations are progressively reduced,

	ineffectiveness of control for some species, and the eventual expansion of large infestations. With time we expect progressively increasing adverse impacts to plant community composition, fisheries and wildlife habitat, and ecosystem services, including production of wild plants gathered by the public for food.	although some management would likely continue as new infestations are discovered and/or new invaders are introduced to the CBJ. Cumulative minor to moderate positive impacts over the long-term due to successful removal of invasive plants from small and large areas of initial infestation, and successful long-term restoration and maintenance of native species, communities, and ecosystem services.

3.0 Affected Environment

This chapter summarizes the relevant physical, biological, and social components of lands contained within the CBJ, some of which could be affected by actions associated with invasive plant management.

The CBJ lies within the Boundary Range and Alexander Archipelago Ecoregions of Alaska (Nowacki et. al. 2001) and encompasses marine waters, estuaries and freshwater wetlands, streams and large rivers, and mountainous terrain covered by spruce-hemlock forests, alpine meadows, glaciers, and the Juneau Ice Field. The population in 2009 was 30,800. The CBJ encompasses many different land ownerships, land uses, and biological communities. Land ownership within the borough includes private property and municipal, state, federal and native corporation lands. As the largest city in southeastern Alaska, the CBJ is the dominant regional transportation and commerce hub. This role has important implications for the inadvertent and purposeful importation of non-native vascular plants to the CBJ and their dispersal to other parts of the region, including relatively pristine habitats.

Land development in the 3,250 square mile borough occupies a small portion of the CBJ. Developed lands within the CBJ are concentrated along a narrow strip of land between the coastline and mountain slopes, in the lower valleys of glacial rivers (e.g., Mendenhall River and Lemon Creek), and on former intertidal and estuarine wetlands that have been filled. The distribution of invasive plants in the CBJ is closely associated with land development that has altered, removed, or disturbed the natural landscape, including the natural vegetative cover and soils (Figure 3.1). These areas include utility right-of-ways, road and trail corridors, neighborhoods, business districts, industrial zones, parking lots, timber harvest sites, and other community infrastructure. Nearly all known invasive plant infestations in the CBJ occur in close proximity to these areas.

Figure 3.1. Documented invasive plant infestations in the CBJ.

3.1 Physical Environment

The CBJ encompasses a geologically and ecologically complex landscape that includes icefields and glaciers, glacial river systems and valleys, angular and rounded mountains, hills and lowlands, streams, wetlands and their associated ecosystems. These distinct landforms and habitats reflect the geomorphic and glacial history of the land. While the area's geology reflects a long period of tectonic processes, repeated overflows of continental ice sheets have shaped the present day landscape by removing, sorting, and depositing geologic materials. Following the last glacial retreat, isostatic rebound, vegetational succession, erosion, and human land-use and development continue to shape the character of the CBJ. Although urban and rural land development has modified a relatively small proportion of the CBJ, land-altering activities have disproportionately modified the most easily developed lands: river valleys and floodplains, estuaries and other wetlands, beaches, and forested lowlands.

An ecoregion (i.e., ecological region) is a large area of land and water that contains geographically distinct communities of plants and animals. Ecoregions are often divided into ecological subsections, areas with unique combinations of geology, rock types, and landforms that influence the land's ability to process water. The CBJ lies within three ecological subsections - the Stephen's Passage Volcanics and Glaciomarine Terrace subsections and the Boundary Ranges Icefields subsection (Nowacki et al. 2001). Douglas Island lies entirely within the Stephen's Passage Volcanics subsection, a type of rounded mountain terrain. In southeastern Alaska, rounded mountain terrain was created by the repeated overriding of angular mountains by Pleistocene continental ice sheets. Relative to angular mountains, rounded mountains exhibit more distinct transitions between forest, subalpine, and alpine zones due to less frequent avalanches, debris torrents, and landslides. The relatively gentle slopes of rounded mountains retain more weathered and depositional sediments than angular mountains. These sediments support a more highly vegetated alpine zone and increase water retention resulting in greater wetland development. Land development on Douglas Island is largely restricted to the lower (< 400 ft. elevation) forested slopes of rounded mountains and hills; some land development has occurred in freshwater wetlands and tidelands. Land cover in this portion of the CBJ consists of spruce-hemlock forest (79%), unvegetated areas (14%), and wetlands (7%).

CBJ lands between Thunder Mountain and Echo Cove lie within the Stephen's Passage Glaciomarine Terrace subsection. Glaciomarine terraces are flat to undulating lowland terrains formed by the repeated overriding of continental ice sheets. Surface geology is dominated by glacial till and outwash deposits. Following the last glacial retreat, isostatic rebound has exposed tidelands that were previously covered by the ocean. The impermeable glaciomarine sediments on these surfaces have developed into extensive wetlands, most notably within parts of the Mendenhall Wetlands State Game Refuge and the area between Peterson Creek and Herbert River locally known as Risen Valleys. Extensive wetland systems in this subsection have also formed over hard-packed till deposits on Spaulding Meadows. Spruce-hemlock forest occurs on well drained slopes and hills, and along incised streams and beachfronts. Land cover in the CBJ portions of this subsection consists of spruce-hemlock forest (66%), unvegetated areas (16%), herbaceous-shrub vegetation (11%), and wetlands (7%).

Although the Mendenhall Valley lies within this subsection, the geomorphology of the valley reflects more recent glacial processes related to the most recent retreat of the Mendenhall Glacier and isostatic rebound of the valley floor. The once submarine valley floor consists of glacial and alluvial deposits overlying marine sediments. Mendenhall River divides the valley in a north-south direction. Land on the west side of the river is largely undeveloped and covered with spruce-hemlock forest. Most of the valley east of the river has been developed for residential, business, and industrial purposes. More than one-third of the CBJ population lives in the Mendenhall Valley.

The remainder of the CBJ, from Thunder Mountain to the end of Thane Road lies on the edge of the Boundary Ranges Icefields ecological subsection. Developed lands in this portion of the CBJ are confined to the lower ends of stream valleys (e.g., Lemon Creek, Gold Creek), a narrow corridor at the base of steep forested mountain slopes, and tidelands that have been filled to construct Egan Drive and downtown Juneau. Spruce and hemlock trees dominate the forest up to the 1500 foot elevation and then gradually give way to mountain hemlock and brush and finally alpine vegetation. Unvegetated land (50%) is the dominant land cover type in this portion of the CBJ, followed by spruce-hemlock forest (22%), herbaceous-shrub vegetation (18%), and wetlands (10%).

3.1.1 Climate

The CBJ experiences a moist maritime climate characterized by wet and cool year-round weather, infrequent and short-duration summer droughts, and transient winter snow cover near sea level. Measureable rainfall (≥ 0.01 inches) occurs on an average of 222 days each year. Storms and moderate to heavy precipitation occur year-round, but most commonly from September through November. The average annual temperature at the Juneau airport is 41 F (range: -22 to 90 F) and annual precipitation averages 57 inches (range: 38-85 inches); annual precipitation can exceed 100 inches in parts of the CBJ. The average growing season is 133 days long.

3.1.2 Soils

Soils develop from parent materials originating from a variety of geological or vegetative sources. Parent material is the inorganic or organic matter in which soils develop. Soil parent materials in the CBJ include glacial deposits; hillslope, stream, and uplifted marine sediments; rock; and deposits of decomposed plant materials. Both mineral and organic soils occur in Juneau. From an invasive plant management perspective, soil productivity (i.e., a soil's ability to support vegetative growth) and the potential loss of soils or off-site effects from management efforts are of principle concern. The productivity of soils directly or indirectly affects the productivity of other natural resources. Soil quality effects the growth of trees and plants and ultimately the quality of fish and wildlife habitat. In general, soil productivity, as measured by tree growth, is greatest in well drained soils. Well drained soils in the CBJ are found on colluvial and alluvial deposits, raised beaches, and adjacent to well incised stream channels, especially in areas of rapid glacial rebound.

Soil erosion in the form of gully, sheet, and rill erosion is a minor occurrence under natural, undisturbed conditions in the CBJ, because the thick surface duff layers that cover the mineral soils protect them from surface erosion. Mineral soils can be disturbed and exposed either by natural causes, such as landslides and blowdown, or management activities, such as land clearing, road construction, and certain invasive plant eradication techniques. Surface erosion can become active once the duff layer is removed and can remain active until revegetation occurs.

Land development in the CBJ often involves replacement of the natural vegetative cover and underlying soils with fill material (e.g., quarry rock, gravel, and sand). Relative to native soils, fill material usually contains fewer nutrients and less moisture, organic matter, mychorhizal fungi, and properties required by native plants. Many non-native plants are able to tolerate these poor soil conditions and, in the absence of resource competition from native species, are able to rapidly develop infestations on disturbed sites. When existing soils are retained during land development, landscaping with non-native species and soil compaction can prevent native species from re-establishing. Loss of forest canopy at developed sites increases solar radiation benefiting invasive species while preventing shade-adapted native species from establishing or thriving.

3.2 Biological Environment

3.2.1 Vegetation

Plant communities within the CBJ are part of a large temperate rain forest that extends along the Pacific Coast from Northern California to Cook Inlet in Alaska.

Most of this forest in the CBJ is composed of western hemlock and Sitka spruce, with mountain hemlock and Alaska yellow-cedar found in certain areas. Red alder is common along streams, beach fringes, and on soils recently disturbed by land development activities and landslides. Black cottonwood grows on the floodplains of major rivers and recently deglaciated and human-disturbed areas. Blueberry, huckleberry, Sitka alder, Devil's club, and highbush-cranberry are common shrubs found below the forest canopy. Smaller understory plants such as flowering dogwood, single delight, fern-leaved goldthread, foamflower, five-leaved bramble and skunk cabbage provide important food for Sitka black-tailed deer. High rainfall and humidity provide ideal conditions for mosses, fungi, and lichens. Grass-sedge meadows usually occur at low elevations, often along beaches. Willows and Sitka alder commonly border stream channels in subalpine areas. Bogs, fens, beaver ponds, scrub-shrub, and emergent wetlands occur throughout the CBJ. The alpine zone occupies the area above the coastal forest and is separated from the forest by a subalpine or transition zone. Resident plants in the alpine zone have adapted to snowpack and wind abrasion by evolving prostrate growth forms. Low, mat-forming vegetation in the alpine consists of cushion-like plants occupying crevices on exposed rock outcrops and talus slopes.

Coastal areas within the CBJ provide valuable habitat for fish and wildlife. Beach-fringe areas, a narrow strip of coastal habitat between tidelands and uplands, often support exceptionally diverse and productive plant and animal communities. Beach-fringe habitats have well drained soils frequently disturbed by wave action and good sun exposure creating ideal conditions for the establishment of invasive plants. Roads and driveways accessing beachfront residences are routes for the introduction and establishment of invasive plants within beach-fringe native plant communities. Invasive plant species commonly found in beach-fringe habitats include perennial sowthistle, sweetrocket, knotweeds, lambsquarters, and orange hawkweed (Figure 1.2). In several locations these plants are displacing ecologically important species such as beach rye grass, lupines, and fireweed.

In developed areas of the CBJ, vegetation is usually composed of a mixture of native and non-native herb, shrub, and tree species. Invasive plant management would maintain primarily native vegetation in undeveloped areas. Non-native plants with invasiveness ranks less than 60 (e.g., pineapple weed, common plantain) adjacent to developed sites would not be managed. The use of invasive plants in vegetable and ornamental gardens would be discouraged through education and outreach by the Service and our partners.

3.2.2 Invasive Plants

In Alaska, the most problematic invasive species are long-lived perennial herbs, shrubs, and trees (Carlson et al. 2008). As a group, these perennials typically propagate both by sexual and vegetative mechanisms. Moreover, new plants are produced both from germinating seeds and, following lateral extension of roots, from sprouting of daughter plants from node sites along roots (e.g., like strawberry). Additionally, most of these species are relatively shade-intolerant and consequently occupy mostly non-forested areas. Non-forested natural habitats in the CBJ that have been infested or are vulnerable to infestation by non-native plants include beach fringes, wetlands, meadows, and the floodplains of braided glacial rivers. Table 1.1 lists invasive plant species currently known to occur in the CBJ.

Certain invasive weeds can achieve high densities in Southeast Alaska, including in the CBJ. For example, in a report prepared for the US Forest Service, Arhangelsky (2007) found that reed canarygrass (*Phalaris arundinacea)* often had a canopy cover of 30-40% in Southeast Alaska. On roadsides where Timothy grass (*Phleum pretense*) was introduced, it covered up to 25% or more of affected areas. White sweetclover (*Melilotus alba*) also tended to form monotypic (single-species) stands with high levels of cover in both Haines and Juneau. In the Juneau area, large infestations of orange hawkweed (*Hieracium aurantiacum*) were found to cover over 50% of some sample plots, and all three clovers (*Trifolium* spp.) occasionally had canopy cover of up to 40% in areas that were surveyed. Orange hawkweed has been observed to develop near-monotypic (i.e., single-species) stands at numerous locations in Alaska (Seefeldt and Conn, 2011).

3.2.3 Fish and amphibians

Fish populations within the CBJ support subsistence, commercial, and sport fisheries. Fish play an important role in traditional and cultural values, and provide valuable wildlife viewing opportunities for residents and visitors. Abundant rainfall and watersheds with high stream densities contribute to a large number and diversity of freshwater fish habitats in the CBJ. These aquatic systems provide spawning and rearing habitats for a variety of resident and anadromous fishes. Maintenance of this habitat, and associated high-quality water, is a focal point of public, state, and federal natural resource agencies, as well as user groups, Native organizations, and individuals.

The CBJ intersects more than 50 watersheds containing streams that have been designated by the Alaska Department of Fish and Game as important to the spawning and rearing of anadromous fishes (i.e. trout, salmon, char). These designated water bodies plus other streams, lakes, and ponds provide habitat for prickly and coastrange sculpins, three-spine stickleback, cutthroat and steelhead trout, Dolly Varden char, and pink, chum, sockeye, and coho salmon. Some of the most important salmon producing watersheds in the CBJ include Montana Creek, Steep Creek, and Auke Creek. Fish populations within the CBJ sustain many people through subsistence, recreation, and commercial fisheries and indirectly through service and support industries to the fishers.

Wetlands in the CBJ are used by several amphibians. These include Columbia spotted frog, wood frog, western toad, and rough-skinned newt (Carstenson et al. 2003). Newts have been found at five locations in the CBJ including in human-created ponds, bedrock ponds, and fens. Western toads have been found in uplift ponds, beaver ponds, and fens throughout the CBJ. Spotted frogs are known from a single site in the Mendenhall Valley and were likely introduced to Juneau. Wood frogs are known from a single location on the west end of Douglas Island.

Invasive plants can have direct and indirect adverse impacts on fish and amphibians and their habitats. Knotweed infestations along streams reduce bank stability resulting in increased erosion and sedimentation. Excess sediment in streams can impact spawning habitat and reduce the abundance of invertebrate prey resources. Reed canarygrass in streams increases sedimentation, obstructs stream flow, blocks fish passage, and reduces habitat quality and quantity for aquatic organisms. The displacement of native plant communities in riparian areas by invasive plants can disrupt important ecological functions. These functions include large wood recruitment to stream channels, organic matter and terrestrial invertebrate contributions to stream food webs, and habitat for birds, mammals, and other species.

3.2.4 Wildlife

Birds and mammals are important components of aquatic and terrestrial ecosystems in the CBJ. In addition to their ecological values, birds and mammals benefit humans, for both consumptive (e.g., hunting and subsistence) and non-consumptive (e.g., wildlife viewing) purposes. Mammal diversity is relatively high in the CBJ compared to other parts of the region due to the borough’s mainland location and overlap with 3 ecological subsections. Mammal species that live in or frequently visit CBJ lands include: northern flying squirrel, red squirrel, hoary marmot, Sitka black-tailed deer, pine marten, American beaver, porcupine, snowshoe hare, black bear, ermine, mink, and several species of mice, shrews, bats, and voles. Mammal species rarely seen in the CBJ, either due to low human tolerance or a lack of suitable habitat include: brown bear, wolf, lynx, wolverine, mountain goat, coyote, and moose.

The high diversity of habitats found throughout the CBJ contributes to a large number of bird species found in the area. About 250 species of birds - 40 resident species and 210 migratory species - regularly occur in the CBJ. Birds commonly found near streams, rivers, lakes, and wetlands include a variety of shorebirds, ducks, geese, terns, gulls, mergansers, bald eagles, and the American dipper. Warblers and thrushes are common in riparian areas and deciduous forests of willow, alder, and cottonwood. Coniferous forest-dwelling species include owls, hawks, crossbills, woodpeckers, pine siskin, Steller's jay, winter wren, chestnut-backed chickadee, red-breasted nuthatch, thrushes, and nesting marbled murrelets. Sparrows, hawks, and falcons frequent meadow and beach fringe habitats. Ptarmigan, hawks, and American pipits occur in the alpine zone. Crows and ravens use a variety of habitats. CBJ habitats are most intensively used by birds between April and October during the migration and nesting periods.

3.2.5 Threatened, Endangered, Candidate Species, and other Species of Concern

No federally threatened or endangered species occur on CBJ lands subject to this EA. Should species within the CBJ become listed under the ESA after adoption of the EA, the Juneau Field Office would analyze proposed activities and undertake Section 7 consultation activities if warranted.

Two candidates for listing under the ESA, Kittlitz's murrelet (*Brachyramphus brevirostris*) and yellow-billed loon (*Gavia adamsiiare*), occur in the waters of Southeast Alaska. While the CBJ is within the range of Kittlitz's murrelet, the species has not been documented within the CBJ. The yellow-billed loon is a winter visitor in marine waters adjacent to the CBJ. Invasive plant management activities in the CBJ will have no effect on these species or on their habitat.

The Alexander Archipelago Wolf (*Canis lupus ligoni*), which has been petitioned for listing under the ESA, and the American Bald Eagle (*Haliaeetus leucocephalus*), a species of concern for the USFWS, both occur within the CBJ. Invasive plant management activities in the CBJ will have no effect on these species or on their critical habitat.

3.2.6 Essential Fish Habitat and Marine Mammals

The Juneau Field Office will consider the impacts of invasive plant management activities on Essential Fish Habitat (EFH) in accordance with the Magnuson-Stevens Fishery Conservation and Management Act and marine mammals in accordance with the Marine Mammal Protection Act. The Juneau Field Office will consult with the

National Marine Fisheries Service on a project by project basis when proposed activities could potentially impact EFH and marine mammals.

3.3 Human Environment

This section summarizes social, cultural, and economic conditions on lands and waters potentially influenced by invasive plant management in the CBJ.

3.3.1 Economy

The CBJ economy is supported equally by two primary sectors: a government sector, including municipal, state, and federal governments, and private sector businesses (JEDC 2010). In 2009, these sectors supported 17,500 jobs and a total payroll of $754.6 million. Government institutions employed 42% of workers and accounted for 50% of the total payroll within the CBJ; the remaining proportion of jobs and payroll were supported by the private sector. The top three categories of private sector employers in 2009 were trade, transportation, and utilities (45%); education and health services (23%); and leisure and hospitality (20%).

3.3.2 Subsistence Use

For the purpose of this assessment, we define subsistence as the practice of harvesting fish, wildlife, or other wild resources for one's sustenance and cultural enrichment - for food, shelter or other personal or family needs. Hunting, trapping, fishing, berry picking, and the harvesting of wild plants are some of the common subsistence activities that occur within the CBJ. Deer, ducks, geese, grouse, and ptarmigan are hunted for food. Salmon, trout, and char taken from freshwater systems within the CBJ are an important source of protein for subsistence users. Many types of plants and fruits are gathered for food, medicinal uses, and for use in art or cultural traditions. Edible plants harvested in the CBJ include salmonberry, blueberry, huckleberry, cloudberry, nagoonberry, thimbleberry, currant, highbush cranberry, devil’s club, twisted stalk, and others. Many of these plants grow within or near invasive plant infestations, therefore in our assessment we evaluate potential impacts on biological resources (including those species that might be utilized by subsistence and recreational users) and we evaluate potential risks to the public, including subsistence users. While invasive plants represent a threat to important subsistence plants, subsistence users represent a potential transport mechanism for introducing invasive plants into new habitats.

3.3.3 Recreation Use

The CBJ possesses a remarkable and unique combination of natural features including coastline, mountains, glaciers, and abundant fish and wildlife populations that provide opportunities for a wide range of outdoor recreation experiences. Some of the outdoor recreation activities pursued by residents and visitors in the CBJ are hunting, fishing, hiking, cycling, boating, kayaking, berry harvesting, beachcombing, and wildlife viewing. Many of these activities occur on extensive trail systems found on a variety of public lands. Trail destinations include public-use cabins, picnic areas, beaches, shelters, alpine areas, and streams and lakes. Due to the widespread distribution of non-native plants in a variety of habitats within the CBJ, recreationist users have a high probability of encountering these plants during outings. As with subsistence users, recreationists are a potential transport mechanism for introducing invasive plants into new habitats. Trails and associated recreation facilities often provide ideal habitat conditions for invasive plants.

4.0 Environmental Consequences

The purpose of this chapter is to identify, describe, and compare the ecological and human health impacts of the alternatives. We apply the following organizational framework. Impacts of alternatives on issues identified in the scoping process and most of the resources described in the previous chapter are addressed under one of three broad subject areas: physical environment, biological environment, and human environment. We assign level of impact (negligible, minor, moderate, major) in accordance to the type, duration, intensity, and area affected by a management practice. We also evaluate the potential cumulative impacts or effects of multiple management actions potentially conducted at many sites over a period of years. Much of the following information pertaining to potential herbicide effects was derived from risk assessments prepared for the USDA Forest Service by Syracuse Environmental Research Associates, Inc. (SERA, 2007, 2011; see http://www.fs.fed.us/foresthealth/pesticide/risk.shtml) and incorporated through reference as identified in 43 CFR 46. We believe these risk assessments are particularly applicable, as our proposed use patterns, application methods (particularly backpack-applied, directed foliar spraying scenarios) and application rates are expected to be similar to those presented in the SERA risk assessments for ground-based foliar applications.

4.1 Physical Environment

4.1.1 Impacts from Alternative 1 to Soils

Soils would be directly impacted by use of manual methods, but the level of effect would differ substantially among classes of invasive species and size of infestation. Effects would be negligible where manual methods were used to remove invasive trees and shrubs, as we assume that most of these species (e.g., European mountain ash) would be readily killed by cutting or girdling the main stem. In contrast, effects would be greatest where manual methods were used to remove rhizomatous perennial invasive herbs (e.g., hawkweeds), and shrub-like herbaceous plants (e.g., knotweeds). The size of an infestation and the number of treatment years required will influence the effect of manual methods on soils. Impacts would be negligible in small infestations comprised of a few plants. In such cases, individual plants would be dug and the roots removed from the soil.

In larger infestations, many people would be required to successfully remove invasive perennial herbs or knotweeds and it would take repeated effort over many years to achieve control and/or halt the spread of infestations, with the distinct possibility that the job would never be complete. In this case, impacts to soil at the site scale (mean infestation size in the CBJ is 0.07 acres) would be large and long-term, but limited in scope to the immediate infestation site. Experience acquired by the JCWMA indicates that most sites would require multiple treatments because removal of all invasive plant roots is seldom achievable (USNPS 2008). In most cases, successful removal of invasive plant roots would require complete removal and disassociation of the topsoil and intermingled roots of all plants. Removal of topsoil would tend to dehydrate it and probably adversely impact soil fauna in and immediately below the topsoil. Topsoil removal, disassociation, replacement, and trampling by personnel involved in the operation would probably reduce infiltration and increase potential for erosion for the duration of the treatment and sometime thereafter. Manual and mechanical control efforts including cutting and digging can modify soil thermal regime, soil moisture, soil nutrients and frost penetration (USNPS 2008). Mechanical techniques may also transport invasive plant seed to the soil surface where they may germinate.

Flaming and burning techniques would kill aboveground weeds, but generally not affect root systems. These activities could affect soil organic matter, moisture and thermal characteristics, however, ash from burns could also enhance soil productivity for one or more growing seasons (USNPS 2008).

Physical barrier methods using plastic products and/or mulches alter moisture regimes (particularly with plastics that would repel water) and soil temperatures (USNPS 2008).

Cumulative effects of Alternative 1 to Soils: The combined applications of all manual methods to all invasive species infestations over a period of years would cause major negative impacts to soils at the site scale and associated physical and biological components and processes in the short-term. These impacts to soils are expected to increase from over the long-term due to the projected increase in size of the largest infestations associated with the likely failure to control new and existing infestations with manual methods. Moreover, soils would be increasingly impacted by replacement of native plants with invasive perennial herbs and shrubs.

4.1.2 Impacts from Alternative 2 to Soils

Effects of manual methods would differ between Alternative 1 and 2. Impacts would be consistent with those described in Alternative 1 where manual methods would be applied to manage small infestations of invasive plants. With larger infestations, the impacts of manual methods would decrease from minor and short-term to negligible and temporary. This conclusion is based on the substantial reduction in physical disturbance to soils associated with management of some invasive plant infestations with chemical methods instead of manual methods.

Chemical herbicides would be used primarily to manage the larger infestations and other infestations of particular species that are difficult or impossible to control using non-chemical IPM methods (e.g. knotweeds). Soils may receive and retain herbicide that is not intercepted by vegetation. Herbicides that reach soil could potentially be transported offsite via surface runoff and/or percolation through soil to ground and surface waters, however the propensity to do so will be chemical-specific. We address potential for impacts associated with proposed use of herbicides to control infestations of invasive plants, below.

Although herbicides would be applied directly to targeted invasive plants, some herbicide residues may reach the soil surface between invasive plants during backpack-applied foliar applications. Little or no such potential exists for cut-stump, wiping or injection application methods. Some of the herbicide applied to plant and soil surfaces potentially could leach into soil subsurface. Movement within the soil would be more likely with aminopyralid, which has greater water solubility, relative to glyphosate which binds tightly to soils and sediments.

Aminopyralid

Aminopyralid is metabolized by soil microorganisms, with the production of carbon dioxide and bound residues in aerobic soils (EPA 2005, PMRA 2007). While information is limited, bioassays suggest that aminopyralid is not very toxic to soil microorganisms (SERA 2007). Based on laboratory studies, the Canadian government (PMRA 2007) concluded that aminopyralid underwent rapid microbial transformation in most, but not all aerobic soils, classifying it as non-persistent to slightly persistent in most soils (half-life of 6–39 days), but they acknowledged that aminopyralid can be persistent in other soils (with a half-life of 330–533 days in one clay soil from North Dakota). The EPA (2005) used an aerobic soil half-life of 103.5 days in its risk assessment for aminopyralid.

Based on field studies, aminopyralid is considered to be slightly to moderately persistent in soil (EPA 2005; PMRA 2007) with field dissipation half-life values (DT_{50}) ranging from 9 to 54 days in North American soils. A field dissipation half-life is defined as the time it takes for 50% of the chemical to be lost from soils via all mechanisms, including microbial action, offsite movement, volatilization or other processes.

Glyphosate

In contrast to aminopyralid, glyphosate has a different mode of action and potential effect in soils (SERA 2011). Glyphosate inhibits the shikimic acid pathway in plants, a metabolic pathway that does not occur in animals (including invertebrates, amphibians, fish, mammals and birds). Some soil microorganisms do possess the shikimate pathway, and a number of laboratory studies suggest that glyphosate can inhibit microbial growth. Field studies of glyphosate are mixed, with some studies showing transient decreases of fungi and bacteria, while other studies report either no effect or an increase in soil microbes or microbial activity. None of the study results indicated any long-lasting or deleterious effects on soil ecology

Glyphosate is readily metabolized by some soil bacteria, with aminomethyl phosphonate (AMPA) as the primary metabolite. Some soil microorganisms can use glyphosate as their sole carbon source (SERA 2011). AMPA is also biologically degradable, with liberation of carbon dioxide (WHO 2005). Degradation of glyphosate occurs more rapidly in aerobic than in anaerobic conditions (WHO 2005). Reported soil half-life values vary greatly, with values from aerobic soils ranging from 1.8 to 180 days, with degradation being much greater in aerobic soils and slower in anaerobic soils (EPA 2008). Similar values were reported for field dissipation half-lives, with values ranging from 1 to 180 days (SERA 2011). AMPA is more persistent in soils than is glyphosate, however AMPA appears to be less acutely toxic than glyphosate to freshwater fish, invertebrates and birds (EPA 2008, EPA 2009).

The persistence of glyphosate has been investigated in Alaska (Newton et al. 2008) at sites near Fairbanks and on the Kenai Peninsula, the latter of which experiences heavy rain and snowfall of approximately 2,250 mm/year (or about 88.6 inches annually). Soils at the Kenai site were always very wet or moist during the study, and the majority of residues detected in soil were within the first 15 cm (or 6 inches), with only 7% of glyphosate residues found deeper than 15 cm. Dissipation of the herbicides tested appeared to be largely due to microbial decomposition, and the authors attribute the presence of the AMPA degradation product of glyphosate to microbial action. Within a year's time, measured glyphosate and AMPA residues in soils had declined to near the limits of detection (Newton et al. 2008). These authors concluded that four unrelated herbicides (including glyphosate) showed similar dissipation patterns, with some degradation occurring during winter months, but with most of the loss occurring during warmer months. They also noted that within a year residues were at or near limits of detection, were immobile, and that these dissipation rates approached those observed in warmer climates. Newton et al. (2008) suggested that microflora adapted to cold climates may be more efficient at degrading these herbicides than was previously thought.

In a study of glyphosate persistence in foliage and soils from a watershed on Vancouver Island, British Columbia, Feng and Thompson (1990) found similar results following an aerial application, with more than 90% of the residues of glyphosate and AMPA detected within the 0 to 15 cm depth soil layer. In this study, glyphosate residues in leaf litter declined rapidly, with a dissipation half-life (DT_{50}) of about 10 days, while AMPA residues in leaf litter were at or below detection limits within 29 days post-application. In soils the authors conservatively estimated a DT_{50} of 45-60 days for glyphosate. After 360 days, glyphosate residues were low (13-18% of initial levels) and AMAP residue concentrations had declined to 6-27% of initial glyphosate residue levels (Feng and Thompson 1990).

Because glyphosate readily binds with soils, particularly with clay and/or high organic matter soils this binding affinity would reduce the probability that the chemical would move offsite via water percolation through soils. Potential for offsite transport and dispersal of glyphosate also is influenced by post-application rainfall which can transport soil particle-bound glyphosate into groundwater or surface water.

Cumulative Effects of Alternative 2 to Soils: The impact of combined IPM actions conducted at multiple sites over a period of years would be minor, short-term and negative. Low level of impact is expected because of the relatively small area that would be subject to management each year. The level of negative impact would be expected to decline from minor and short-term to negligible and temporary with a progressive reduction in the total area of infestation subject to management. Negative impacts are not expected to decline completely because surveys would likely reveal new infestations that would require additional management.

4.1.3 Impacts from Alternative 1 to Water Quality

Application of cultural, manual and mechanical methods would negligibly influence water quality over the short-term. With small infestations in upland settings, the potential for topsoil to erode and flow into surface waters would be low, due to minimal soil disturbance associated with removal of invasive plants of small infestations, even when repeated removals were required over a period of years. However, treatment of large infestations would potentially cause major short-term impacts. This would be attributed to a substantially increased potential for soil erosion due to the increase in the area of disturbance associated with removal of topsoil and invasive plant roots. Additionally, topsoil would need to be disturbed repeatedly over a period of years to ensure complete removal of rhizomatous perennial invasive herbs, grasses, and shrubs. Slope pitch and density of vegetation following invasive removal also would influence erosion potential. Finally, the probability that eroded sediment would enter and temporarily degrade water would be related to distance between the treatment area and water body. Treatment of infestation areas closest to water bodies would have greatest potential to produce sediment that could affect water and habitat quality.

Cumulative effects of Alternative 1 to Water Quality: The impact of combined IPM actions (excluding herbicide use) conducted at multiple sites over a period of years are expected to be minor and negative. The use of cultural, manual and mechanical methods would potentially increase soil erosion and consequent sedimentation into adjacent water bodies, however potential impacts would be localized and depend on various factors including distance from water, soil type, and gradient. Impacts are expected to remain relatively consistent because the area subject to treatment would not appreciably change due to funding limitations and personnel available to treat only the largest, highest priority sites. Because these cultural, manual and mechanical efforts would likely fail to fully eradicate some invasive plant species, we anticipate that the area requiring treatment would eventually exceed available resources and invasive species would increasingly dominate vegetation composition. We would expect water quality to be adversely affected where vegetation density decreased and soil erosion potential increased following conversion from native plant communities to communities dominated by non-native invasive species.

4.1.4 Impacts from Alternative 2 to Water Quality

Effects of cultural, mechanical and manual methods would differ between Alternative 1 and 2. Impacts would be consistent with those described in Alternative 1 where these non-chemical methods would be applied exclusively to manage infestations comprising a few invasive plants (e.g., 10 or fewer individuals per infestation area). With larger infestations, the impacts of non-chemical methods would decrease in Alternative 2 from minor, short-term negative effect to a negligible, short-term effect, due to greater reliance on chemical control measures. Soil erosion and sedimentation potential would be substantially reduced in Alternative 2 because we would not severely disturb soil and protective vegetation cover to remove invasive plant roots from some larger infestations. Instead, herbicides would be used to kill invasive plants while leaving most of the cover of non-target plants intact. On sites where invasive species dominate ground cover, controlling the invasive species with herbicide could temporarily remove most of the protective ground cover of vegetation. In such a case, potential for erosion and sedimentation would temporarily increase then decline following revegetation of the site.

Potential to increase soil erosion would also likely differ with the type of herbicide used. Because aminopyralid is a more selective herbicide which specifically targets certain plant families, we would expect less potential for erosion relative to glyphosate, which is a relatively non-selective herbicide that would be expected to impact a larger suite of non-target plants.

Potential for contamination and degradation of water quality are influenced by many factors including infestation size, herbicide type, application rate and method, proximity to water, soil composition, and rainfall following application. The herbicides proposed for use in this alternative are not expected to substantially degrade water quality, as discussed below.

Aminopyralid

In aquatic systems, a laboratory study shows that aminopyralid is rapidly degraded by sunlight (photolysis) in clear water with a half-life of 0.6 days (EPA 2005), but this process may be less efficient when light is intercepted by suspended matter or in deeper waters where less light penetration occurs (PMRA 2007). Aminopyralid that is not degraded by sunlight is expected to be persistent, particularly under anaerobic conditions (EPA 2005; SERA 2011).

Laboratory studies suggest that aminopyralid has high water solubility and may be subject to leaching. Despite these properties, aminopyralid adsorbs more tightly to soils than some other similar auxin-inhibiting broadleaf herbicides, including clopyralid (Bukun et al. 2010) and picloram (Fast et al. 2010). Clay minerals can significantly influence the amount of aminopyralid adsorbed to soils (Bukun et al. 2010, Fast et al. 2010). Two field dissipation studies indicate that aminopyralid is likely to be relatively non-persistent and immobile in the field, with soil half-lives of 32 and 20 days in U.S. soils, and minimal leaching below soil depths of 15 to 30 cm in most soils (EPA 2005), however residues can reach 90 cm or more when significant rain events follow application (PMRA 2007).

SERA (2007) concluded that potential for offsite movement of aminopyralid via surface runoff was insubstantial except in areas of hard-packed clay soil. This risk assessment also concluded that risks associated with transport of aminopyralid by wind erosion were low.

We do not expect aminopyralid applications to measurably degrade water quality due to very low application rates using spot-application methods in upland locations. Aminopyralid is considered to exhibit low toxicity to invertebrates and vertebrates (SERA 2007). Consequently, even if low concentrations of aminopyralid reached surface waters, the amount would be small, it would be rapidly dispersed and/or diluted, and it would be unlikely to cause any acute or chronic impairment of invertebrates and vertebrates. Potential effects on aquatic resources are discussed in more detail in Section 4.2.9, while potential risks to the general public, including any risk associated with aminopyralid residues in drinking water are evaluated in Section 4.3.4.

As described under soil impacts, aminopyralid would only be applied to small infestations (less than one-acre) in upland areas. Aminopyralid is also used at much lower application rates than alternative herbicides, limiting the amount of product that could potentially be transported to water. Potential for offsite movement of the herbicide would be further minimized by adherence to label requirements and best management practices. Potential for contamination of water via airborne drift of small droplets of herbicide would be minimized by restriction to directed foliar backpack spray application, spray tank pressurization sufficient to achieve large spray droplet size, and application during dry weather conditions when wind was minimal.

Glyphosate

A commercial glyphosate formulation approved for use within upland and aquatic systems would primarily be used to manage invasive species that cannot be managed using aminopyralid (e.g., grasses). It also would be used to manage any invasive species at sites that occur adjacent to surface water. We would use a directed foliar backpack sprayer, cut-stem, wiping, or injection methods of application as appropriate, depending upon target species and location. In contrast to aminopyralid use, application of glyphosate would be allowed near and over water using a formulation registered for aquatic habitats. Offsite mobility and transport of residual glyphosate would be limited because most residues would bind with soils and sediments.

Given its affinity for soils, leaching to groundwater and traveling in surface water in a dissolved state is minimized, however surface waters could be exposed to residues bound to soil particulate matter (EPA 2008). Areas subject to the influence of potential herbicide effects would be limited to infestation sites.

The major mechanism for glyphosate loss identified in laboratory studies is microbial degradation. The half-life of glyphosate in aerobic water-sediment systems is 7 days, and the half-life of glyphosate ranged from 8 to 199 days in anaerobic water-sediment systems (EPA 2008).

Additionally, the already low potential for water quality degradation would decline through progressive reduction of infestation size and subsequent declines in application area(s) with time within the CBJ. As noted previously, glyphosate use would be limited to commercial formulations that did not contain the surfactant POEA (i.e., polyethoxylated tallow amine), which has been shown to be toxic to some aquatic organisms. Per label directions, we would add a surfactant such as AGRI-DEX® to promote glyphosate efficacy. AGRI-DEX® is the least toxic of the glyphosate-compatible surfactants to aquatic organisms and fish studied to date (Monheit 2004, Smith et al. 2004).

In summary, proposed uses of herbicide would have no effect on water quality.

Cumulative Effects of Alternative 2 to Water Quality: The impact to water quality from invasive species control actions using all available IPM techniques, conducted at multiple sites over a period of years, are predicted to be negligible. This conclusion is based upon several factors including limited projected area of treatments, limited use of soil-disturbing manual and mechanical control methods, limited mobility of residual herbicides in the environment, low toxicity of herbicides to invertebrates and vertebrates, use of a surfactant with low aquatic toxicity, the application of best management practices to minimize erosion from manual and mechanical methods, and the application of best management practices to minimize damage to non-target species and reduce risk of exposure to aquatic resources. Since most documented infestations of priority invasive species in CBJ occur in uplands, it is likely that new infestations also would occur primarily in uplands and few would occur in seasonal or semi-permanently flooded sites. Despite expected success at reduction and elimination of currently known infestations, we suspect that new infestations would be identified and some would require treatment with herbicide. We therefore conclude that while herbicide use could be required periodically over the long-term at some new infestation sites, given the small size of most new incipient infestations, we expect that water quality would continue to be negligibly affected.

4.2 Biological Environment

The CBJ has a large area of disturbed lands and other habitats that are vulnerable to invasive plant infestations. Absent management these species would increase in distribution, abundance, and negative ecosystem influence as described in Section 4.1.1. On the most suitable sites, invasive species could eventually displace native vegetation. Increased displacement of native vegetation would result in the alteration of the plant community, habitat quality, and ecological functions. Though knowledge is limited about influence of these species on functional relationships, much is known of their influence on community composition and structure. For example, conversion of native plant communities to knotweed-dominated monocultures in the CBJ reduces the quality of these areas as wildlife habitat. Displacement of native plants by invasive non-native species has been documented in other areas of Alaska (USNPS 2009) and throughout the Pacific Northwest (Fierke and Kauffman 2006, IPCBC 2008, Urgenson et al. 2009).

Invasive plants can gain a competitive advantage over native plant populations in a number of ways. For example:

> Garlic mustard, a highly invasive species found in CBJ, can interfere with symbiotic fungi that help trees with uptake of water, mineral salts and to fight off pathogens. This in turn may influence tree seedling establishment and biogeochemical cycling (Wolfe et al., 2008).
>
> The highly invasive Bohemian knotweed (*Fallopia X bohemica*) may gain a competitive advantage over other plants primarily through limiting access to light, but this species may also exert allelopathic (chemical) interference that affects germination and seedling growth of other plants. And Bohemian knotweed may affect microbial soil organisms, which in turn will affect native plant populations (Siemens and Blossey 2007). And in animal feeding trials invasive species (particularly garlic mustard and spotted knapweed) were consumed much less frequently than native plants from the same plant families. Both of these species are known to have strong anti-herbivore defenses, namely phytochemicals which discourage consumption (Jogesh et al. 2008).

In Europe, research has shown that the highly successful invader *Impatiens glandulifera* (found within CBJ) attracted many more pollinator visits per flower than a native *Impatiens* species (due to higher pollen quantities, high concentrations of nectar, and high nectar sugar concentrations) and the invasive plant produced many more seeds per plant, leading to its success as an invader that is rapidly spreading across the landscape (Vervoort et al., 2011).

Purple Loosestrife (*Lythrum salicaria*) which has been found in CBJ, has spread at the rate of 100,000 hectares per year in the United States, in turn reducing biomass of at least 44 native plant species and reduced some animal populations including a turtle and several duck species (Pimentel 2009).

Due to the large number of widely distributed invasive plant species found in the CBJ, we consider their current overall ecological impact to be moderate. Without intervention, impacts are expected to increase from moderate to major over the long-term where invasive species substantially increase in distribution and abundance. Absent management, it is highly likely that such increases would continue to occur over the long-term.

4.2.1 Impacts from Alternative 1 to Terrestrial Vegetation

Vegetation would be directly impacted by application of manual methods but the level of effect would vary primarily in relation to density and size of infestations coupled with the level of mixture of invasive and non-target plants. Effects would be negligible where manual methods were used to remove invasive trees. Specifically, it is assumed that impacts would be negligible where infestations of invasive shrubs and trees (e.g., European mountain ash) were limited to a few individuals that minimally affected surrounding vegetation, as these species could be controlled by girdling or similar techniques. In contrast, effects on non-target vegetation would be greatest where manual methods were used to remove rhizomatous perennial invasive herbs (e.g., hawkweed) and shrubs (e.g., knotweed), a result confirmed by the experience of JCWMA members engaged in manual treatment of knotweed infestations. Level of effect of manual methods applied to this class would correspond to infestation size and number of years requiring treatment. Impacts would be negligible in small infestations with few invasive plants. In such cases, individual plants including roots would be dug; however, seeds and viable rhizome fragments may remain in the surrounding soil. Adjacent non-target plants would be removed or injured as needed to facilitate complete removal of invasive plants. In larger infestations, the effect would be moderate because many people would be required to successfully remove invasive perennial herbs at a site, which would take repeated effort over many years, with the distinct possibility that the job would never be complete. Experience acquired by Kodiak NWR staff and the National Park Service on such removal projects indicated that removal of all invasive plant roots is seldom achievable for some plant species (USNPS 2008). It would take several years for non-target vegetation to recover from disturbance following treatment. In such cases, we would injure and kill some non-target plants because, in most cases, invasive plants would be intermixed with non-target plants and successful removal of invasive plant roots would require topsoil and non-target plant removal, disassociation, replacement, and trampling by personnel involved in the operation. Active revegetation of treated sites through seeding and transplanting would be utilized to accelerate recovery of habitat values. Physical barrier methods using plastic products and/or mulches would affect plants by blocking light, altering moisture regimes (particularly with plastics that would repel water), alter soil temperatures (USNPS 2008), and would be non-selective, impacting both target and non-target plant species.

Cumulative Effects of Alternative 1 to Terrestrial Vegetation: The combined applications of non-chemical methods to invasive species infestations within CBJ over a period of years would cause minor short-term negative impacts to non-target vegetation. This consequence is attributed mainly to the limited area where manual methods would be applied to manage priority invasive species in the CBJ. However, negative impacts would increase from minor to moderate over the long-term due to the likely failure to eliminate or contain the larger infestations which would tend to displace native species and dominate the landscape.

4.2.2 Impacts from Alternative 2 to Terrestrial Vegetation

Effects of manual methods would differ between Alternative 1 and 2. Impacts would be consistent with those described in Alternative 1 where manual methods would be applied to manage infestations comprised of a few invasive plants (e.g., 10 or fewer per infestation site). With larger infestations, the impacts of manual methods would decrease from a minor short-term negative effect to a long-term positive effect. This result would be attributed to: (1) greater likelihood of successful site restoration through the use of herbicide, in conjunction with manual methods that would not severely disturb soil; (2) and an increase in non-target vegetation following decrease in invasive plants following treatment.

Herbicides would be used primarily to manage the larger infestations and/or infestations that are not readily controlled using non-chemical methods. The potential effects of the two proposed products on non-target vegetation would differ considerably, given differences in factors such as chemical fate and selectivity. In general, herbicides would be applied to reduce and eliminate invasive plants and to increase native plant populations. Below we address differential impacts associated with these two proposed herbicides.

In general, impacts of herbicide application would be minor and short-term to non-target vegetation in treatment areas. Impacts would be minimized by reliance on ground-based herbicide applications targeted to invasive plants. Despite such targeted application, some herbicide would be inadvertently applied to non-target plants and soil surfaces where invasive and non-target plants were intermixed. This would be less of an issue with monocultures (i.e., single-species stands) of invasive plants.

Aminopyralid Impacts on Terrestrial Vegetation

With application of the herbicide aminopyralid, certain types of broad-leaved forbs, but not grasses, would be injured or killed where it was applied to foliage or absorbed by roots of non-target plants (SERA 2007). Aminopyralid exhibits some residual activity in soil, so the potential effects of both direct spray and soil exposure were evaluated by the SERA (2007) risk assessment. Risk analysis suggested that tolerant species such as grasses could be sprayed directly with no adverse effects anticipated, however sensitive non-target plants would be at risk across the entire range of permitted applications rates (SERA 2007).

Spray drift presented the greatest risk to sensitive non-target plants (SERA 2007); however, direct foliar application using a backpack sprayer presented less potential spray drift risk to non-target plants compared with other delivery methods.

Glyphosate Impacts on Terrestrial Vegetation

With glyphosate applications, most forbs and grasses would be injured or killed where it was applied to foliage (SERA 2011) as it is a relatively non-selective herbicide. The unintended direct spray of non-target vegetation is likely to injure or kill these plants, as would be expected with an effective herbicide. Because glyphosate is relatively immobile in soil, absorption by roots of non-target plants would be unlikely. The dissipation of glyphosate residues in Alaskan vegetation occurred rapidly, with glyphosate degradation exhibiting an exponential decrease (Newton et al. 2008). These authors note that these results were similar to vegetation dissipation rates observed elsewhere.

Non-target native vegetation could also be adversely impacted inside and outside a treatment area by spray drift during herbicide application. Drift associated with backpack applications (directed foliar applications) are expected to be much less than those from ground broadcast applications or aerial applications, however no detailed studies are available regarding drift associated with backpack applications (SERA 2011).Potential for spray drift would be minimized by adherence to herbicide label requirements and stipulations that reduce drift, and adoption of best management practices including sprayer pressure, droplet size and wand orientation when spraying, that should reduce off-site drift.

Sullivan and Sullivan (2003) reviewed 60 journal publications evaluating the broadcast spraying of glyphosate in forest and agricultural ecosystems, evaluating impacts on the diversity of terrestrial plants and animals. This synthesis paper will also be discussed in the Terrestrial Wildlife section (Section 4.2.6). For terrestrial plants, Sullivan and Sullivan (2003) found that for 83% of studies evaluated, species richness (i.e., the number of species present in an area) and species diversity (which includes both the variety and abundance of different types of organisms in an area) either were unaffected by glyphosate application or increased, particularly herbaceous plants. They noted that one study that did observe a decrease in the richness of shrub species following treatment of a conifer plantation. The authors note that some individual plant species were reduced following these treatments, but other “pioneer” species colonized the area, resulting in minimal changes in overall diversity. They also noted that because glyphosate lacks long-term residual herbicidal properties (i.e., residues in soil do not generally affect plants through root uptake), seed banks within the soil were often sufficient to allow recovery of native species. Because our proposed treatment areas in CBJ are expected to be smaller than the treatment plots evaluated in the Sullivan and Sullivan (2003) analysis, we would expect even fewer impacts on native plant diversity and species richness, resulting from our proposed herbicide treatment of smaller, more widely distributed infestations.

Cumulative Effects of Alternative 2 to Terrestrial Vegetation: The net effect of the full range of proposed IPM actions conducted at multiple sites would be negative and minor over initial years of treatment. Some non-target vegetation would be injured or killed and therefore adversely affected where they were intermixed with invasive plants and herbicides inadvertently reached non-target plants. However, we conclude that the overall scope of the impact within CBJ would be negligible because of the limited area subject to management, use of a directed foliar application method, targeting of application primarily to foliage of invasive plants, and herbicide selectivity in the case of aminopyralid.

The degree of impacts would be expected to shift from negative, minor, and short-term to positive, moderate, and long-term in response to progressive reductions in the area of invasive plant infestations and a corresponding increase in native vegetation. Over the longer-term, the benefits associated with control and eradication of invasive plants would substantially outweigh the expected negligible impacts that could be associated with the periodic treatment of newly discovered infestations as they are discovered.

4.2.3 Impacts from Alternative 1 to Terrestrial Wildlife

Application of individual cultural, manual and mechanical treatments would negligibly and, in many sites, temporarily affect wildlife. This assessment is based on several factors including relatively small size of infestations, limited duration of treatment operation at most sites, and limited influence of treatment on wildlife habitat resources found in infestation sites. Animals that would be affected least would be those with the largest seasonal home ranges exemplified by deer and bear. Individuals of either species would not rely to any significant degree on food and cover resources within such small areas occupied by currently known infestations. Nonetheless deer and bear may be temporarily displaced where they occurred within or near an infestation site at the time of treatment.

In contrast, the smaller animals, particularly invertebrates, small mammals, and songbirds, would be affected most by a treatment. It is likely that even these taxa would be substantially affected only in the case of treatment of the larger infestations (e.g., exceeding one-tenth acre). Effects would consist primarily of habitat loss and displacement due to relatively prolonged human activity in the treatment area, possibly ranging over several days in each year of treatment and the physical loss of habitat through intrusive control methods. In the case of small songbirds, some may nest in the infestation area and these nests could be lost or could fail due to disturbance. Birds that foraged in the treatment area could also be displaced during the time of treatment. Small mammals and invertebrates in the treatment area would be displaced by the loss of vegetative cover and disturbance to soils as required for removal of perennial invasive plant roots.

Cumulative Effects of Alternative 1 to Terrestrial Wildlife: The combined applications of cultural, manual and mechanical methods of treatment to all invasive species infestations over a period of years would cause negligible short-term impacts and minor long-term negative impacts. Initial impact would be minimal because the treatment would influence a relatively small portion of the total wildlife habitat encompassed by the CBJ. Beneficial effects to fish and wildlife over the long term would occur in those areas where infestations are controlled and eliminated. However, negative impact would increase to minor and eventually to moderate over the long term in correlation with the gradually increasing area where the vegetated component of wildlife habitat shifted from dominance by native species to dominance by invasive plant species. This change in plant dominance would result from the likely eventual failure of cultural, manual and mechanical methods to control and contain the larger and more aggressive invasive plant infestations, such as knotweeds and reed canarygrass.

4.2.4 Impacts from Alternative 2 to Terrestrial Wildlife

Effects of cultural, mechanical and manual methods would differ between Alternatives 1 and 2. Impacts would be consistent with those described in Alternative 1 where cultural, manual and mechanical methods would be applied to eliminate infestations comprising a limited number of invasive plants (e.g., 10 or fewer per infestation area). With larger infestations, the impacts of Alternative 2 would consist of minor, temporary negative effects eventually replaced by minor, long-term positive effects. Such a result would be attributed primarily to the change in vegetation composition induced by treatment. Similar to Alternative 1, infestation treatment in Alternative 2 would include short-term degradation of habitat within infestations of 10 or fewer individuals. Degradation of habitat would be associated with manual removal of topsoil and vegetation to facilitate removal of invasive plant roots and rhizomes. Vegetation composition, a primary constituent of wildlife habitat, would be disrupted and altered by implementation of either alternative. Extensive application of manual methods (Alt. 1) or a combination of manual and herbicide methods (Alt. 2) would reduce cover and forage used by invertebrates, landbirds, and mammals following treatment. However, these potential declines would be minimal since infestation sites would likely have experienced substantially less usage compared with similar non-infested sites (i.e., the infestation would have already reduced wildlife usage, so the additional effect of treatment would be less discernible). Declines in wildlife food and cover would persist under Alternative 1 due to likely failure to eradicate some infestations. In contrast, effects on wildlife habitat would decline with time under Alternative 2 as the area treated decreased. Recovery of native plant communities following treatment with herbicide(s) would be accelerated through seeding and planting with native species.

Under Alternative 2, the risk of direct toxicological impacts to wildlife is low (SERA 2007, 2011). However, we acknowledge that wildlife might be affected indirectly by herbicide use, particularly through secondary impacts (reduction in food/cover). We estimate that these secondary impacts would be insubstantial for the following reasons:

- The herbicides chosen would be limited to those regarded as having low toxicity to non-target organisms, applicators and the general public;
- Surfactant used would also be limited to a low-toxicity product (e.g., AGRI-DEX® or similar alternative product).

- Low volumes of herbicide would be applied directly to foliage via backpack sprayers, by wiping herbicide onto leaves and stems, or by direct injection into plant stems;
- Substantial decline in herbicide use is expected in successive treatments with eventual cessation of herbicide use at any given infestation site as eradication is achieved; and;
- The relative size of infestation areas is small; few presently exceed more than one-quarter acre.
- Changes in vegetation type and/or abundance might affect some wildlife through loss of forage or cover in the near term, however we do not expect those effects to be long-lived. Some of these potential impacts will be mitigated by planting of native vegetation within treated areas.

The effects of aminopyralid and glyphosate on invertebrate and vertebrate animals have been reviewed and summarized in US Forest Service risk assessments (SERA 2007, 2011).

Testing of herbicide effects on animals typically involves species that are readily propagated and manipulated for experimental purposes. The governing assumption is that the range of species tested is representative, in terms of physiological processes, of taxonomically related species. Consequently, results from studies of herbicide toxicity on rats, mice, rabbits, and dogs are extrapolated to other mammal species (SERA 2007). To extrapolate animal toxicological responses to herbicide exposure under field conditions, results from toxicity studies are further modeled and evaluated in risk evaluations that examine potential direct and indirect worst-case exposure scenarios involving maximum anticipated application rates and accidental exposure from spillage.

Aminopyralid Impacts on Terrestrial Wildlife

Though limited in scope, available results from toxicity and exposure studies indicated that aminopyralid is of low toxicity, non-carcinogenic, and non-mutagenic, to mammals (SERA 2007). Furthermore, the SERA (2007) risk assessment, which evaluated toxicity information relative to expected environmental concentrations, indicated that aminopyralid should not adversely affect mammals, birds, aquatic or terrestrial invertebrates. Birds were more sensitive to aminopyralid exposure than mammals, however despite using conservative assumptions, risks to birds were below levels of concern even at the highest application rates (SERA 2007). Given these characteristics, aminopyralid-based commercial herbicide formulations have been classified as a "Reduced Risk" herbicide (EPA 2005) by the U.S. Environmental Protection Agency (EPA).

While direct toxicity to birds, mammals and terrestrial invertebrates is not expected, SERA (2007) did note the potential for secondary effects on some species through changes in vegetation, which in turn can affect habitat and food availability. These secondary effects may be beneficial to some species and detrimental to others (SERA 2007). Over time following herbicide treatment, recovery of the native plant community is expected to increase the availability and quality of habitat for wildlife.

Glyphosate Impacts on Terrestrial Wildlife

Potential effects of glyphosate would differ from aminopyralid. Many of the toxic effects reported for glyphosate have been attributed to chemical surfactants contained in certain commercial formulations registered for use in terrestrial upland areas (SERA 2011). Under this alternative, the Service and our cooperators would only utilize commercial glyphosate formulations that lack these surfactants.

Tu et al. (2001) also reviewed results from studies of glyphosate effects. They concluded that glyphosate was minimally toxic to birds, mammals, and invertebrates and unlikely to directly or indirectly impair animal health, particularly when applied at low volumes via backpack-applied directed foliar spray.

More recently, SERA (2011) assessed potential risks associated with glyphosate applications to terrestrial environments. Within the risk assessment they found that:

> At application rates of 3.75 lb a.e./acre (greater than our expected concentrations) for less toxic glyphosate formulations like Aquamaster, the risk to terrestrial mammals was below the level of concern by a factor of 50.
>
> At the same application rate of 3.75 lb a.e./acre, potential risks to birds were even less likely, with the calculated risk below the level of concern by a factor of 5000.
>
> For terrestrial invertebrates, SERA (2011) did not analyze risks of less toxic formulations, as they assumed the less toxic formulations would primarily be used for aquatic treatments. Risks to aquatic invertebrates are discussed in Section 4.2.9. The SERA (2011) risk assessment predicts adverse effects on direct-spray application of formulations containing surfactants (like Roundup) to honeybees at concentrations that exceed our anticipated application rates (i.e., at rates above 3.3 lbs/acre). No adverse effects are expected in bees exposed to spray drift. Further, most field studies involving Roundup, and other formulations that contain surfactants, suggest that effects on terrestrial invertebrates will be

> minimal and changes in terrestrial invertebrate populations are likely associated with vegetation changes. We do note, however, that some studies conducted with a formulated product used in South America may indicate some potential risk for spiders at moderate to high exposure rates (SERA 2011). Given the presence of an undisclosed surfactant in this formulated product, it would not be appropriate to extrapolate those findings to formulations of glyphosate registered for use in aquatic habitats.

Finally, SERA (2011) concludes that “the less toxic formulations of glyphosate do not appear to present any risk to terrestrial organisms other than terrestrial plants.”

While the likelihood of direct toxicity to terrestrial wildlife appears to be minimal, indirect effects associated with changes in vegetative cover and/or forage plants are possible, at least with larger-scale applications.

As mentioned previously, Sullivan and Sullivan (2003) evaluated the effects of broadcast glyphosate application on the diversity of plants and animals in agricultural and forested systems. In their review, the diversity and richness of terrestrial invertebrates were variable in glyphosate-treated areas as this is a very diverse group of organisms which differed in their response to treatment. In general Sullivan and Sullivan (2003) found that some species like carabid beetles and microarthropods increased on treated units, with similar results for butterflies, gastropods, macroarthropods, and nematodes. Many herbivorous species and some spiders declined after treatment, however. Sullivan and Sullivan (2003) attributed changes in abundance and diversity of invertebrates to changes in the composition of the vegetation community.

In their literature review, Sullivan and Sullivan (2003) found that three (out of seven) studies reported declines in some songbird species in at least the first post-treatment year. In many cases, the total number of individual birds increased, the number of species (richness) decreased, and some common species dominated. In particular residents, short-distance migrants, ground gleaners and conifer nesting species generally increased following treatment (Sullivan and Sullivan 2003). In general, some songbirds that prefer brushy deciduous cover often decreased while species preferring open habitats and conifers cover increased. They also noted that the biological significance of these shifts in species number and diversity are small when comparing changes with natural fluctuations in bird communities from untreated control areas (Sullivan and Sullivan 2003).

Sullivan and Sullivan (2003) observed no significant reductions in overall species richness or diversity of small mammals in glyphosate-treated areas. They did note that some vole and shrew species were reduced in abundance while deer mice and other vole species generally increased, while the number of chipmunks was generally unchanged. And again they concluded that the magnitude of observed changes were within the range of natural population fluctuations.

For larger herbivorous mammals, responses were more variable. For example, a study that examined glyphosate influence on deer foraging found neither aversion to glyphosate-sprayed foliage nor reduction in rate of plant consumption (Sullivan and Sullivan 1979). A study of moose in Maine, however, found decreased usage of clear-cut areas that were sprayed with glyphosate vs. untreated clear-cuts during the first 1-2 years, likely due to reduced browse availability. Moose usage was higher in sprayed areas (compared to untreated areas) at 7-11 years post-treatment however, likely due to greater presence of cover vegetation, rather than browse availability (Eschholz et al. 1996). Sullivan and Sullivan (2003) cited studies of black-tailed and white-tailed deer that did not reduce their use of treated conifer stands, presumably because the herbivorous plants they fed on had stable or increased abundance. These same authors also cited papers showing decreased populations of mountain hares following spraying of forest plantations, while long-term changes in snowshoe hare abundance, survival, growth and reproduction were not observed following glyphosate treatment.

Considering these results, we cannot discount the potential for changes in terrestrial wildlife abundance following glyphosate application, related to changes in overall vegetative abundance and shifts in plant species composition. It also seems clear that responses may range from negative to positive effects, depending on the species and how they respond to changes in the plant community. We also note the relatively small size of infestations in CBJ, the presence of some infestations in already marginal habitat (roadsides) and the broad geographic distribution of individual sites. These factors may limit the potential for indirect impacts on wildlife habitat and wildlife use, at least in comparison to published studies that involved the treatment of large test plots that involved tens or acres or more.

Cumulative Effects of Alternative 2 to Terrestrial Wildlife: The combined application of IPM methods of treatment to all invasive species infestations over a period of years would cause negligible short-term negative impacts and minor to moderate long-term positive impacts. Initial impact would be negligible because the treatment would influence a relatively small portion of the total wildlife habitat encompassed by the CBJ. The negligible impact would result from reduction of wildlife food and cover for one to two years following herbicide application to a very small portion of the CBJ wildlife habitat. Additionally, birds and mammals would be temporarily disturbed and displaced by activity of personnel engaged in field operations at treatment sites. Invertebrates would be displaced from treated sites until a new native plant community became established. Herbicide effects would be negligible due to the small size of treatments, low herbicide volumes, directed ground-based application methods, and, the low toxicity of the two herbicides to wildlife, and limited mobility and moderate persistence of aminopyralid and glyphosate. Negligible short-term negative impacts would be replaced by minor to moderate long-term positive impacts as wildlife food and cover were restored at treatment sites.

<u>4.2.5 Impacts from Alternative 1 to Aquatic Resources</u>

Implementation of Alternative 1 would result in a negligible short-term effect to aquatic resources in the vicinity of infestation sites. Application of non-chemical methods would increase potential for erosion and sedimentation where efforts were made to manage the largest infestations. Erosion potential would be influenced by infestation size and the area subject to removal and disassociation of topsoil, as required for removal of roots of perennial invasive plants.

Cumulative Effects of Alternative 1 to Aquatic Resources: The combined applications of cultural, manual and mechanical methods of treatment to all invasive species infestations over a period of years would cause negligible short-term impacts and minor long-term negative impacts. Initial impacts would be minimal because the treatment would influence a relatively small area, the bulk of which consist of terrestrial habitat. Impacts would consist of increased potential for erosion and sedimentation associated with soil removal and disassociation required for invasive plant removal. However, impacts would increase to minor and negative over the long-term in correspondence with gradually increasing area where terrestrial and riparian habitat shifted from dominance by native species to dominance by invasive plant species. This change in plant dominance would result in negative effects to aquatic habitat quality associated with the likely eventual failure of manual and mechanical methods alone to control the largest and most aggressive invasive plant infestations.

<u>4.2.6 Impacts from Alternative 2 to Aquatic Resources</u>

Impacts would be consistent with those described in Alternative 1 where manual and mechanical methods would be applied to eliminate infestations comprised of a few invasive plants (e.g., 10 or fewer per infestation area). With larger infestations, the impacts of Alternative 2 would consist of a negligible and temporary negative effect and a minor to moderate long-term positive effect. This assessment is based on several factors including the relatively small size of infestations, limited duration of treatment operation, and limited influence of treatment on aquatic habitat resources near and adjacent to infestation sites. Although herbicides would be used to manage the larger infestations, it is unlikely that herbicide use would measurably degrade aquatic habitat resources.

Herbicides used to treat terrestrial vegetation have the potential to enter water bodies and affect aquatic organisms through direct application into aquatic environments (of herbicides approved for use in these habitats), through accidental spraying, through accidental spills, or through the movement of herbicides from upland areas to nearby water bodies via groundwater, surface runoff, or subsurface transport.

The primary factors that determine the potential influence of herbicides on aquatic resources include herbicide type, herbicide volume, application method, mobility and dissipation of residual herbicide, and location of application in relation to water bodies.

Glyphosate Impacts on Aquatic Resources

Under this alternative, commercial glyphosate formulations that contain proprietary surfactant compounds that are restricted to terrestrial habitats would not be used.

Field and laboratory studies indicate that both glyphosate and its major metabolite AMAP adsorb strongly to soil, and it would not be expected to leach to groundwater, however residues adsorbed to soil particles may be suspended in runoff (EPA 2009).

SERA (2011) reviewed potential effects of glyphosate on aquatic resources including aquatic invertebrates, amphibians and fish. Risk assessment findings related to glyphosate exposure and some specific study results are discussed in detail, below.

Glyphosate - Accidental Spills

The SERA (2011) risk assessment evaluated both accidental spill scenarios and potential impacts associated with typical use patterns. When evaluating potential spill impacts, the effects of a spill of fairly large volumes of glyphosate (of 20, 100 and 200 gallons) into a relatively small pond (about ¼ acre surface area, and about 3.2 feet deep) were assessed. Accidental spills of the less toxic formulations of glyphosate are expected to result in harm to sensitive aquatic invertebrates, fish, algae, and aquatic plants. Risks to sensitive amphibian species were below levels of concern during all accidental spill scenarios. Given these anticipated risks, we and our cooperators will adopt a spill prevention plan and best management practices that should mitigate these risks. Examples of mitigation measures would include, but not be limited to: 1) mixing and handling of herbicides at least 50 feet from any waterbodies, 2) using chemically resistant barriers or portable containment systems when filling application equipment such as backpack sprayers, and ensuring field crews are equipped with appropriate response tools including sorbent materials and shovels.

Glyphosate - Fish

SERA (2011) concludes that potential risks to sensitive fish cannot be ruled out when applications of the less toxic glyphosate formulations are applied directly to water at rate above of about 2.5 lbs (acid equivalent or a.e.) of glyphosate per acre, and they further conclude that effects would be most likely in stressed fish populations, but less likely with healthy fish. Given this conclusion, and the importance of fish as both a natural resource and as important subsistence foods within CBJ, the potential for effects on fish are considered in this EA.

We anticipate that our typical application rates will be similar to average rates used by the Forest Service during backpack applications (about 2 lbs a.e./acre) and that our applications will rarely if ever exceed 3 lbs glyphosate a.e./acre. Using the SERA (2011) spreadsheets to estimate potential for impacts, application of 3 lbs a.e./acre glyphosate generally did not result in risks to fish, and the "upper bound" of risk modeling suggested only a slight risk to fish (specifically, a "hazard quotient of 1.1 where values above 1.0 indicate some potential for effects).

We then considered results of acute toxicity tests on four species of Pacific salmon: coho, chum, chinook and pink salmon and rainbow trout (results from Wan et al. 1989, summarized in SERA (2011) relative to expected water concentrations following application of 3 lbs glyphosate a.e./acre (our highest projected use rate), applied directly to water. Peak water concentrations anticipated were nearly 20 times lower than acute toxicity values (LC_{50}) for the most sensitive salmonid species tested (chum salmon and rainbow trout) when tested under the most conservative conditions (in low pH or "soft" waters). [Note: the LC_{50} in these studies = lethal concentration that killed half the fish tested within a 96 hour period].

SERA (2011, citing Holdway and Dixon 1988) also discusses the fact that these LC_{50} are likely conservative, as standard testing methods involve testing fish that are not fed for the duration of the test (in the above example six days). When comparing toxicity values for fasted vs. fed fish, the LC_{50} of fed fish exposed to technical glyphosate was 10-fold higher (i.e., the herbicide was approximately ten times less toxic when fish were fed). These results appear to have contributed to SERA's conclusion that stressed populations might be more susceptible to glyphosate exposure than healthy fish.

Longer-term (chronic) testing of fish elicited effects on fish at application rates (around 5 lbs a.e./acre) that were considerably higher than our highest proposed application rate.

Stehr et al. (2009) evaluated effects of glyphosate (lacking a surfactant) on fish development and found no impairment to growth or reflexes.

Some glyphosate products (primarily the Roundup formulation that contains POEA surfactants) have been evaluated for potential sub-lethal effects including general stress responses, gill damage, avoidance behavior and immune system effects, with some effects noted (SERA 2011). In many (but not all) of these studies, relatively high exposure rates were used, resulting in test water concentrations that exceed expected environmental concentrations. We cannot with any confidence extrapolate these results to our proposed use of Aquamaster or similar glyphosate products that lack these surfactant(s).

SERA (2011) notes that "Several field studies indicate that the application of glyphosate to control aquatic weeds is beneficial to fish populations," with specific examples outlined in one of the Appendices. Some of these reports are anecdotal and involve fish species not found in Alaska, therefore while we note these findings, they only minimally inform our evaluation of potential risk and benefits.

Considering all of the information available to us, including the small size of most infestations, and the fact that most infestations are not in or adjacent to water, we conclude that risks to fish populations should be minor or negligible.

Glyphosate - Amphibians

Potential impacts of various glyphosate formulations on amphibians have been extensively studied. For the more toxic glyphosate formulations that contain POEA or similar surfactants, amphibians appear to be the group at greatest risk both in terms of sensitivity and severity of effects. In contrast, risks to amphibians and aquatic invertebrates appear to be insubstantial for the less toxic formulations (SERA 2011), such as Aquamaster and other products labeled for aquatic use.

Glyphosate - Aquatic Invertebrates

The SERA (2011) risk assessment concluded that *"As with fish and amphibians, the risks associated with the less toxic formulations of glyphosate are minimal"* and that at the maximum aquatic application rate of 3.75 lb a.e./acre, hazard quotients are still well below levels of concern.

Laboratory and field studies support this assessment. For example Henry et al. (1994) observed no mortality of caged invertebrates following aerial application of glyphosate (Rodeo) and a surfactant. Linz et al. (1999) found after aerial application of glyphosate to wetlands that most invertebrate populations either were not affected, or populations increased. The increases in aquatic insect populations were attributed to a reduction in cattail density in treated areas.

Glyphosate - Algae and other Aquatic Vegetation

As noted in SERA (2011) the aquatic formulations of glyphosate are registered and labeled for use in controlling aquatic vegetation. Accordingly, sensitive species of aquatic plants would be affected by application of less toxic glyphosate formulations, with hazard quotients exceeding levels of concern at application rates within the typical use rates we would apply. This risk assessment notes that other aquatic plants are more tolerant, and likely would not be affected. For example, duckweeds (*Lemna* species) are more sensitive than eelgrass to glyphosate acid. We therefore anticipate that at least some non-target plants could be affected by applications conducted near water.

Glyphosate - Aquatic Wildlife

Neither aminopyralid nor glyphosate are known to bioaccumulate in fatty tissues of organisms (SERA 2007, 2011) and therefore we do not predict biomagnification (i.e. increasing concentrations from one level to another within a food chain) of these herbicides.

Field studies using Rodeo (an aquatic-registered glyphosate product) noted an increase in waterfowl abundance in treated areas, which was attributed to changes in vegetation and creation of open water habitat (several relevant studies are cited in SERA 2011).

Aminopyralid Impacts on Aquatic Resources

Review of bioassay and toxicity studies indicate that aminopyralid should exhibit low toxicity to aquatic resources including invertebrates and fish (SERA 2007).

Aminopyralid - Fish

Based on available toxicity information and worst-case exposure modeling, adverse effects on fish are not expected (SERA 2007). The greatest potential risks were associated with exposure of sensitive fish to an accidental spill of aminopyralid into a small pond (similar to the glyphosate example described above), with a resulting hazard quotient 10 times lower than the level of concern. Risks to sensitive fish following exposure to the highest allowable aminopyralid application rate ranged from 50 to 500 times below levels of concern (SERA 2007).

Aminopyralid - Amphibians

Larvae of the Northern leopard frogs (*Rana pipiens*) were not sensitive to aminopyralid during toxicity testing with no observed mortalities and sublethal effects observed at the highest concentration tested, 95.2 mg a.e./L, which classifies this herbicide as being practically non-toxic (PMRA 2007; EPA 2005). In contrast, SERA (2007) estimates peak water concentrations in a small stream in Glacier Bay National Park, Alaska (a high rainfall site, with applications to sandy soils) to be 0.13 mg/L, or more than 700 times less than the observed no-effect concentration. Comparing the leopard frog with other species, its sensitivity is similar to tolerant fish species (SERA 2007). We also note that risks to fish, other vertebrates (birds and mammals) and invertebrates are all below levels of concern. Thus, we have no basis to conclude that amphibian risks will reach levels of concern, however we acknowledge that there is more uncertainty associated with this determination, compared with the risk calculations for most other taxonomic groups. We also note that we are employing application strategies (including limiting application to spot spraying in upland locations, with buffers around waterbodies), further reducing potential risks relative to those calculated in the SERA (2007) analysis.

Aminopyralid - Aquatic Invertebrates

The risk characterization for aquatic invertebrates, based on acute and longer-term toxicity testing, indicates that they should exhibit sensitivities similar to fish. The highest calculated risk is for sensitive species exposed to an aminopyralid spill to a small freshwater pond, with hazard quotients about 17 times below levels of concern (SERA 2007). The upper bound of risk posed by non-accidental application of aminopyralid to water at the highest labeled rate results in values below levels of concern by factors of about 1,400 to 3,300.

Aminopyralid - Aquatic Plants

The aminopyralid risk assessment (SERA 2007) does not predict adverse effects on aquatic plants. The greatest predicted risk is for exposure of sensitive algae to aminopyralid following an accidental spill into a small pond, with a risk quotient below the level of concern (0.8 where values over 1.0 indicate potential risk). Risks associated with exposure of sensitive algae to aminopyralid following the maximum legal application rate were below levels of concern by a factor of 100 to 200, while risks to emergent plants was even less (with risks below levels of concern by a factor of 500 to 1,400).

Surfactants

Under this alternative, the non-ionic surfactant AGRI-DEX® will be used to enhance efficacy of aquatic-registered glyphosate, such as Aquamaster® and aminopyralid, such as Milestone™VM. Presently the surfactant AGRI-DEX® has been identified as being practically non-toxic to rainbow trout and other aquatic resources, and is less toxic than alternative surfactants (Smith et al. 2004). In a scenario where a 2.5% solution of surfactant with herbicide, it was estimated that direct application of AGRI-DEX® to water would result in toxicity to rainbow trout at water depths of 0.2 inches or less. At depths greater than 0.2 inches, no adverse effects were detected, probably because of dilution of the surfactant in greater water volumes.

Contributing factors expected to minimize the potential effect of herbicides on aquatic resources include directed ground-based application methods, interception of most of the herbicide by target plants, limited mobility in soils and relatively rapid dissipation of residual herbicide (SERA 2007, 2011). In most cases, herbicide would be applied to invasive plant infestations in terrestrial upland environments. Potential for offsite movement of aminopyralid would be further minimized by adherence to label stipulations and by a voluntary prohibition of applications within 20 feet of any water body.

When applying pesticides in riparian areas and wetlands, transport to water could occur and aquatic organisms including fish could be exposed to residual herbicides and surfactants. However, as described above in some detail, it is unlikely that effects would be detrimental given low toxicity of the aquatic-labeled glyphosate formulation and selection of a low-toxicity surfactant; rapid adsorption by suspended and bottom sediments (glyphosate); and relatively rapid biodegradation for glyphosate (SERA 2011, Smith et al. 2004).

Cumulative Effects of Alternative 2 to Aquatic Resources: The combined use of the full range of IPM methods (cultural, manual, mechanical, and chemical treatments) to address invasive species infestations in the CBJ would over a period of years cause negligible short-term negative impacts and minor to moderate long-term positive impacts to aquatic resources. Initial impacts would be negligible because combined treatments would affect a relatively small portion of the area encompassed by the CBJ, and most of the treatments would be restricted to terrestrial uplands. The negligible impact would consist of potential entry and circulation of trace amounts of herbicide and surfactant into water inhabited by salmonids and their prey. However, potential for exposure would be minimized by conservative application practices, low volume application rates, and relatively rapid dissipation and biodegradation of chemicals. Over the long-term, aquatic resources would benefit from management under this alternative to the extent that native vegetation was successfully restored on the larger infestation sites. An approach that emphasizes early detection and rapid response would also help ensure that smaller newly discovered infestations would not expand and proliferate (e.g., FICMNEW 2003). This benefit would increase from minor to moderate through time in direct relationship to the area that could have been occupied by invasive species had the preferred alternative not been implemented.

4.3 Human Environment

4.3.1 Impacts from Alternative 1 to Worker Safety and Health

Effects on human health and worker safety would be negligible and temporary. Actions associated with manual methods of invasive plant management may include digging, cutting, sawing, scything, stooping, and lifting. Actions associated with mechanical methods of invasive plant management may include use of motorized weed trimmers. Potential manually induced injuries could include sprains, strains, blisters, and cuts to hands, arms, knees, and backs. Potential mechanically-induced injuries could include being struck by flying debris, cuts, burns, sprains, and strains. Direct hazards associated with manual and mechanical methods are readily predicted and controlled, but may never be fully eliminated. Worker safety would be enhanced by adherence with manufacturer product safety standards, as appropriate, job hazard analyses, and training of workers in equipment use, and use of appropriate safety equipment.

Cumulative Effects of Alternative 1 to Worker Safety and Health: Management actions under this alternative would be relatively infrequent and of limited duration, perhaps a week for the largest projects, and furthermore restricted to the period between May and October. Provision of training and adherence to safety standards would minimize the probability of risk and injury.

4.3.2 Impacts from Alternative 2 to Worker Safety and Health

Effects described in Alternative 1 would also apply to Alternative 2 with respect to management of infestations partially or entirely with cultural, manual and mechanical methods. Although these non-chemical control methods also would be applied to manage large infestations, the scope would be more limited primarily to removal of invasive plants (i.e., pulling); mowing invasive plant stands; clearing dead standing non-target vegetation from the vicinity of invasive plants; and cutting non-target shrubs to facilitate access to invasive plants growing amidst shrubs.

Large infestations would be managed with an IPM approach that included allowance for herbicide use. The types of worker activities associated with herbicide use would include:

- Transportation between the headquarters storage site and a field storage site (e.g., administrative units) or between the headquarters storage site and the field mixing site;
- Mixing chemicals with water in a backpack spray tank;
- Walking over uneven terrain with a loaded backpack sprayer weighing between nine and 36 pounds (i.e., weight of one to four gallons plus equipment);
- Applying herbicides directly to foliage with backpack sprayers, or by dabbing herbicide on cut shrub and tree stems, or by injecting herbicide directly into shrub stems;
- Cleaning, calibrating and maintaining application equipment; and
- Handling and proper disposal of disposable PPE such as Tyvex® coveralls, commercial herbicide containers, and broken application equipment.

Potential risks associated with the handling and use of aminopyralid and glyphosate were evaluated extensively in US Forest Service risk assessments (SERA 2007, 2011). Notable conclusions from these assessments are summarized below.

Aminopyralid Impacts of Worker Safety and Health

Aminopyralid is considered to have low toxicity to mammals including humans (SERA 2007).

The lethal oral dose of aminopyralid has not been determined because aminopyralid did not cause any mortality at the EPA's highest dosing limits for acute oral toxicity studies. Similarly, subchronic and chronic toxicity studies failed to demonstrate any clear signs of systemic toxic effects (SERA 2007).

Based on the results of chronic bioassays as well as the lack of effects in several mutagenicity screening assays, "… there is no basis for asserting that aminopyralid is a carcinogen …" (SERA 2007). Aminopyralid has been classified as "not likely" to be carcinogenic to humans (EPA 2005).

Based on chronic bioassays and subchronic bioassays in mice, rats, dogs, and rabbits, "…there is no basis for asserting that aminopyralid will cause adverse effects on the immune system or endocrine function…" (SERA 2007).

The EPA (2005) concluded, based on the available toxicological information, that "…dermal exposures do not result in any adverse systemic effect ..".

Short- and intermediate-term oral and inhalation risks were evaluated based on the results of a rabbit developmental toxicity study. The EPA (2005) concluded that the highest potential human exposure was to Mixer-Loaders working on aerial applications involving the treatment of 1,200 acres per day . Margin of Exposure (MOE) for these activities is 40,000. For context, EPA generally considers MOE's greater than a value of 100 to not be of concern.

The primary hazard to workers involves potential aminopyralid exposure to skin, eyes, and lungs through direct contact with liquid or inhalation of vapors. Skin and lung exposure are not known as health risks.

The technical product is a server eye irritant (EPA 2005), however eye contact with the end-use formulation is will cause moderate irritation. Tests of accidental oral ingestion indicated that most of the aminopyralid was rapidly excreted in unchanged form.

SERA (2007) concluded that there was "…no basis for suggesting that adverse effects are likely in either workers or members of the general public even at the maximum application rates…"

EPA (2005) notes that the formulated end-use product (Milestone) has low toxicity and is classified in toxicity category IV [Caution], which is the least toxic of the four pesticide human health hazard categories.

Glyphosate Impacts on Worker Safety and Health

Information on the toxicity of glyphosate is extensive, including standard toxicity tests required during the pesticide registration process and studies that have been published in the open scientific literature over a 30 year period.

Glyphosate is not readily absorbed by humans or other mammals, with limited dermal (i.e., through the skin) absorption. Once in the body, glyphosate is not extensively metabolized, with more than 95% of the chemical excreted unchanged (SERA 2011). Exposure scenarios within the risk assessment (SERA 2011) evaluated dermal exposure by immersion and accidental spills. Most of the occupational exposure for workers and some exposure to members of the public would involve dermal contact.

Glyphosate is considered to be of low toxicity to mammals including humans, and potential risks to applicators appear to be low. For example:

The EPA has previously concluded that no evidence of neurotoxicity was observed during toxicity testing (USEPA 1993).

Based on a review of available animal and epidemiological studies, the U.S. EPA has concluded that glyphosate should be classified as a “Group E, No Evidence of Carcinogenicity” (i.e., available evidence does not suggest glyphosate is cancer-causing), and SERA (2011) agreed with the EPA’s conclusions.

SERA (2011) notes that EPA’s has stated in past assessments that glyphosate is neither mutagenic (i.e., causing heritable mutations) or clastrogenic (i.e., causing chromosome breakage). The SERA (2011) risk assessment further discusses a published study of technical grade glyphosate that suggests mutagenic activity in exposed fruit flies; however the threshold for mutations was considerably higher than concentrations we would expect following field applications.

Technical glyphosate causes slight skin irritation and is classified as Category IV (least hazardous category). Formulations like Aquamaster which contain primarily only glyphosate and water with no surfactants are classified as either non-irritating or only slightly irritating to skin. Even when not required by the label, we typically require applicators to wear protective clothing (long sleeve pants/shirts, gloves, and boots) to avoid potential dermal contact.

The EPA has classified technical glyphosate as mildly irritating to the eyes (Category III), and surfactants are probably the cause of eye irritation that is associated with some glyphosate formulations (SERA 2011). As a precaution, we typically require that workers wear eye protection when mixing and loading backpack sprayers, to reduce risks from splash when handling the concentrated formulations.

As noted above, glyphosate is poorly absorbed through the skin, therefore toxicity from dermal exposure is likely to be lower than from oral exposure (through food or water), however "*there is relatively little difference in the oral and dermal toxicity of glyphosate, because glyphosate is relatively non-toxic by either route*" (SERA 2011).

Due to its very low vapor pressure, inhalation exposure levels for workers applying glyphosate are low, relative to dermal exposure (SERA 2011). Their analysis compares potential effects concentrations (from toxicity testing) vs. maximum measured concentrations found in the air during glyphosate applications. In this comparison, levels of concern were a factor of 20,000 higher than measured air concentrations (SERA 2011).

SERA (2011) reviewed the literature associated with endocrine disruption and glyphosate, including both the technical product (active ingredient) and formulations. In reviewing the various studies presented in this risk assessment it appears that in general, formulated products with surfactants had more potential for endocrine effects, relative to technical glyphosate. Glyphosate itself generally appears to have low or equivocal potential for endocrine disruption. Further, where endocrine effects were observed, they were observed at concentrations well above our expected exposure rates and/or were associated with formulated products containing proprietary surfactants which are not proposed for use under this EA.

The US Forest Service's risk assessment (SERA 2011) evaluated accidental exposures to workers using reasonably conservative assumptions, including immersion of a worker's hand in glyphosate for one hour, and a spill on a worker's leg with no cleanup for one hour. Potential risks to workers were well below levels of concern for accidental exposures by a factor of 100 or more.

Occupational exposures related to normal spray operations were also well below levels of concern. For example using the maximum aquatic application rate of 3.75 lb/acre, a worker would need to spray more than 250 acres in a single day to exceed the occupational level of concern (SERA 2011). While the exposure assessment for workers is based on modeled calculations, the document compares calculated exposure rates vs. the results from three different published studies that determined exposure via biomonitoring of workers that had applied glyphosate using backpack equipment. SERA (2011) found good concordance between the modeled exposure estimates and measured exposure rates derived from biomonitoring of applicators.

Worker safety during herbicide application would be ensured by routine application of standards for transportation, storage, and use described in:

- Labels and Material Data Safety Sheets (MSDS) for commercial herbicide formulations;
- Job Hazard Analyses;
- Integrated pest management plans; and
- Pesticide use proposals.

Potential hazards would further be minimized by routine maintenance of application equipment, supervision and training of applicators by a certified pesticide applicator, applicator use of personal protective equipment (PPE) that meets or exceeds label requirements, and provision of first aid equipment at treatment sites. Under this alternative we would adopt the same suite of operational standards and practices to minimize exposure and risk of herbicide storage, transportation, and use. Based on this assessment we conclude that use of an IPM approach allowing for judicious use of herbicide would have low potential for negative effects on worker health and safety.

Cumulative effects of Alternative 2 to Worker Safety and Health: The combined applications of the IPM approach allowing for herbicide use to all invasive species infestations over a period of years could cause minor temporary negative impacts to worker safety and health. This assessment includes consideration of potential injuries and hazards involved with physical control measures. It also considers potential effects related to herbicide use. Herbicide applicators will often have to carry a fairly heavy load over uneven terrain. Herbicide applicators may repeatedly handle and apply both of the proposed herbicide types at multiple project sites over a period of years. However, the total area treated in any given year will be relatively small and is not expected to exceed 2 acres. The two types of herbicide proposed for use have low mammalian toxicity and consequently the inherent level of health risk to workers is minimal and readily mitigated through full compliance with worker training requirements, herbicide label stipulations, and agency standards for safe herbicide storage, transportation, use, and disposal.

4.3.3 Impacts from Alternative 1 to Public Safety, Health, and Access

For the purposes of this section, we detail potential effects of the proposed alternatives on safety, health and access of the public and non-public. As described here, the public consist of visitors engaged in subsistence or recreational use of CBJ lands. The “non-public” consists of USFWS employees, contractors, and cooperators directly engaged in invasive plant management activities on the CBJ; and seasonal and permanent residents of private land, in cases where owners request the Juneau Field Office and its partners to undertake invasive plant control operations on those sites.

Implementation of Alternative 1 would have a negligible temporary effect on public and non-public access and uses. This alternative involves the same type and scope of management activities and related potential hazards as described in 4.3.2 under worker safety with the exception of field transportation concerns. The potential for injury to public and non-public would be minimal since they, unlike workers, would not be involved in the management activity. To further minimize potential safety risk, entry and access to infestation sites would be temporarily closed during implementation of cultural, mechanical and/or manual control activities. It is also likely that some areas will be marked/flagged/signed following the management activity — both to facilitate public safety and to help ensure public access does not increase erosion or disturb re-vegetation projects.

Cumulative Effects of Alternative 1 to Public Safety, Health, and Access: A negligible temporary effect would result from the combined effects of management at all infestation sites over a period of years. In contrast to workers directly engaged in management activities, the public would not be at risk from physical hazards associated with non-chemical control measures, as they would have no role in these operations. Furthermore safety and health risk would be minimized by notifying the public and non-public of site management plans, and by closing or signing/posting of sites during management operations. Public access likely will be discouraged for an extended period of time at some sites to minimize erosion potential and/or to foster successful re-vegetation.

4.3.4 Impacts from Alternative 2 to Public Safety, Health, and Access

Impacts to the safety of public and non-public uses would be consistent with those described in Alternative 1 where cultural, manual and mechanical methods would be applied to eliminate infestations comprised of a few invasive plants (e.g., 10 or fewer per infestation area) or in instances when control could be achieved without use of herbicides. With infestations that require herbicide use, the impacts of Alternative 2 also would consist of a negligible temporary effect. This assessment is based on several factors including the relatively small size of infestations and the very low potential for direct or indirect exposure to herbicides proposed for use. Direct contact could consist of contact of herbicide liquid to skin and eyes or inhalation of herbicide vapors. Direct contact with herbicide liquid and vapors would likely only occur during the actual application, and those potential impacts are addressed above under Worker Health and Safety (Section 4.3.3). The public could, however, come into direct contact with treated vegetation or soils which could retain some residues. While it is less likely, other potential exposure scenarios include contact while swimming and drinking waters that contain herbicide residues. Indirect contact could consist of ingestion of vegetation, meat, or water containing herbicide residue. These various issues are discussed in more detail, below.

Entry and access to infestation sites would be temporarily closed during and after herbicide application. It is also likely that some areas will be marked/flagged/signed following herbicide application to facilitate public safety and to help ensure public access does not increase erosion or disturb re-vegetation projects.

Since the public would not be involved in management activities, the main sources of potential health risk would be direct contact with herbicide on infestation sites immediately following herbicide application, exposure from ingestion of contaminated vegetation, meat, or water. Skin exposure would be the most likely exposure scenario for people accessing sites where herbicide was recently applied. We would reduce the likelihood of this type of inadvertent exposure by notifying public, employees, and non-public of site management plans. Additionally, we would close public places to entry, and post signage consistent with State of Alaska pesticide requirements, during and immediately following herbicide application for a period specified on the herbicide label. We may elect to leave signs in place for a longer period than required by the label and/or State guidelines. In particular, should we treat areas with high public use; we will choose to err on the side of longer notification periods. In the case of private lands, we would coordinate with landowners and require signage and the same standard of access and re-entry restriction of residents and their pets.

Under this alternative it would be improbable that public health would be jeopardized because herbicide would be applied to invasive species and only incidentally applied to intermixed non-target vegetation, which would rarely (if ever) be consumed by people.

Glyphosate

Glyphosate may be applied to manage certain species of invasive plants that could not be managed with aminopyralid, and otherwise it could be used on invasive plants at sites where we will not apply aminopyralid, such as riparian areas and wetlands. Some of the glyphosate applications could occur directly over water. In flooded wetland sites the potential for glyphosate entry into water would be relatively high. In riparian sites the potential would be low where soil was dry, moderate where soil was saturated and high where soil was flooded.

Potential for health risk associated with human intake of contaminated water or fish would be negligible for the following reasons. We would restrict glyphosate use to commercial formulations registered for broad-spectrum use, including aquatic sites.

Upon contact with soil, most residual glyphosate would rapidly bind to soil and sediment and be biodegraded by microorganisms. Upon contact with water, residual glyphosate would rapidly dilute, bind to suspended and bottom sediment, and biodegrade. Such binding would substantially reduce the potential for ingestion of residual glyphosate by fishes or organisms that served as fish food.

Public exposure to glyphosate has been extensively reviewed (SERA 2011). A synopsis of exposure scenarios and key findings are summarized below.

In its risk assessment (SERA 2011), the US Forest Service concluded that the chances of the general public being exposed to glyphosate is highly variable, as they might apply herbicides in recreational areas, camp grounds, picnic areas, and trails in addition to more remote areas. The wide range of exposure scenarios evaluated in the SERA (2011) risk assessment would bracket potential herbicide uses proposed by the Service and its cooperators within the CBJ.

In evaluating potential public exposure, SERA (2011) uses some very conservative, if not extreme, exposure assessments. These scenarios should encompass and/or exceed any credible exposure scenarios that may be encountered in CBJ. One fairly extreme example from SERA (2011) includes:

> Direct spray of a young naked child with the herbicide so that 100% of the surface area of the body is covered. This scenario is intentionally extreme and is used when considering the "most exposed individual". Another direct-spray scenario involves a young woman of reproductive age that is accidentally sprayed on the feet and lower legs.

Other scenarios evaluated in the SERA (2011) assessment that are more plausible include:

> A young woman wearing shorts and t-shirt coming in contact with treated vegetation after spraying (skin exposure).
>
> A young woman swimming in water for one hour following application.
>
> Consumption of contaminated vegetation (both short- and long-term), including both fruit/berries and vegetation (e.g., grasses). Because vegetation treated with glyphosate shows signs of injury rather quickly, long-term consumption exposure is evaluated although long-term exposure may be less likely than short-term exposure (due to damage or loss of the vegetation).

Consumption of contaminated fish by the general public and subsistence populations, both short-term and long term was also reviewed.

Accidental exposure scenarios evaluated included:

A young child ingests contaminated water after an accidental spill of a fairly large volume of glyphosate (scenarios for 20, 100 and 200 gallons) into a relatively small pond (about ¼ acre surface area, and about 3.2 feet deep).

Consumption of fish by adult males and by subsistence populations following a spill.

SERA (2011) evaluated these various scenarios and concluded that for members of the general public, the only scenarios that would exceed levels of concern were:

1. A young child drinking 1.5 liters of water (or about 1.58 quarts) following a spill of 200 gallons of herbicide into a small pond. This scenario indicated borderline risk (hazard quotient of 1.0, where HQ's over 1.0 indicate risk). While this scenario is extremely unlikely, it does highlight the need for best management practices which mitigate potential spill risks. Best management practices intended to reduce or eliminate spill risks were discussed previously in Section *4.2.9 Impacts from Alternative 2 to Aquatic Resources*.

2. Consumption of contaminated vegetation presented some risk at Roundup application rates above 1.4 lbs a.e./acre, which is within the range of expected application rates described in this EA. Given these findings, the Service evaluated the SERA risk assessment, its worksheets and the scientific literature when considering potential implications for the public within CBJ, particularly focusing on any possible exposure to subsistence users.

   Within Southeast Alaska, berries including blueberries, salmonberries, and huckleberries are commonly consumed subsistence foods, with median consumption rates ranging from 2-7 pounds per year, and with maximum reported consumption amounts ranging up to 79 pounds per year for highbrush salmonberries and blueberries (Ballew et al. 2004). Blueberries are a particularly popular food item, with 94% of those surveyed reporting some level of consumption (Ballew et al. 2004). As noted above, berries and fruits, due to their surface to volume ratios have lower concentrations of herbicides, compared to leafy vegetation (particularly grasses).

Rose hips are also consumed by some subsistence users in Southeast Alaska, with median consumption rates of 3 pounds per year, and maximum reported consumption rates of 29 pounds per year. Rose hips were not as common a dietary component as berries, however, with only 3% of those surveyed reporting some level of consumption (Ballew et al. 2004). Given their shape and smooth surface, rose hips (the rose fruit) would be predicted to retain glyphosate residues in a similar fashion to other fruits and berries. We therefore conclude that rose hips may not present risks that exceed berry consumption, which are reviewed below.

The SERA (2011) risk assessment concluded that, unlike vegetation (e.g., leaves and grass), consumption of fruits did not present any short-term or long-term consumption risks to the public. Given their shape and surface-to-volume ratios, we expect berries to be more similar to fruits rather than leafy vegetation, when considering uptake of herbicides. We used the SERA spreadsheets to calculate potential fruit consumption risks at application rates up to 3 lbs a.e./acre (our projected maximum application rate), finding risk levels below levels of concern for both short-term and longer-term exposures. This suggests that consumption of berries exposed to glyphosate residues should also be below calculated risk levels.

Given the importance of berry consumption in Southeast Alaska, we also reviewed the open literature for relevant studies. Roy et al. (1989) evaluated the uptake and persistence of a glyphosate formulation in wild blueberry and red raspberries in Canada. They found that less than 10% of the glyphosate penetrated the raspberries in the first 9 hours, and less than 14% of the glyphosate had penetrated blueberries after 9 hours, with the remaining residues being dislodged via washing.

Initial residues were greater in raspberries than in blueberries, not unexpected given their greater surface area that could retain herbicide. Residues dissipated fairly rapidly, with dissipation half-live (DT_{50}) of less than 13 days in raspberries and less than 20 days in blueberries (Roy et al. 1989). Their application rate was 2 kg active ingredient per hectare (or about 1.78 lbs/acre). We then used the SERA (2011) spreadsheet to compare predicted residues in fruit following a 1.78 lb/acre application with the actual residues in berries measured by Roy et al. (1989). Initial residues observed by Roy et al. (1989) were approximately 8 mg/kg in blueberries and about 19.5 mg/kg in red raspberries. These values are very comparable to values predicted by SERA (2011) which calculates an “average” (or central tendency) value of 12 mg/Kg, and an “upper bound” concentration of almost 27 mg/kg in fruit. This comparison suggests that the SERA exposure models provided representative, conservative estimates of residues of fruit/berries following field application of glyphosate.

Finally, we evaluated the raspberry concentrations observed by Roy et al. (1989) in light of the 2 mg glyphosate/kg body weight/day reference dose (i.e., the adverse effect dosage, on a per kg body weight basis) used in SERA (2011). To reach toxic levels, a 65 kg (143 pound) woman would need to consume 14 pounds of contaminated raspberries per day. It seems unlikely that a single person would be able to gather these quantities of freshly-sprayed berries from the relatively small and scattered treatment plots, and then have one individual consume this amount of sprayed berries in a single day.

In summary, after careful evaluation, we conclude that consumption of berries and fruits (including rose hips) should not present undue risk to residents in CBJ. Any potential risk, should it exist, would further be mitigated by public outreach, signage posted at application sites, fairly rapid dissipation of residues in treated plants, and the dislodgement of residues through washing in water (a common food-handling practice).

Aminopyralid

During the pesticide registration process EPA (2005) explicitly considered use of aminopyralid on campgrounds and other recreation areas to control vegetation, resulting in potential short-term oral exposures for infants and children through hand-to-mouth ingestion of aminopyralid-contaminated grass and soil. For children with a 15-kg body weight exposed in this manner, the EPA calculated a Margin of Exposure (MOE) of 150,000 (EPA 2005). For context, EPA generally considers MOE’s greater than a value of 100 to not be of concern. The EPA also considered cumulative human risks from multiple sources including food, drinking water, and short term incidental oral ingestion (i.e., oral exposure of children to residues in campgrounds treated with aminopyralid). When EPA aggregated these exposure estimates for the highest exposed group (children 1-2 years of age), they calculated an MOE estimate of 32,000, which greatly exceeded the acceptable limit (MOE = 100). Thus EPA concluded that “…there is reasonable certainty that no harm will come from aggregate exposure to aminopyralid residues…” (EPA 2005).

In assessing potential risks to the general public associated with aminopyralid use, SERA (2007) used the same types of exposure scenarios described above for glyphosate, including direct spray of a child, spraying the legs and feet of a young woman, skin contact with sprayed vegetation, consumption of contaminated water following direct spraying of water, a scenario involving an accidental spill into a shallow pond followed by consumption of contaminated water by a child, and scenarios involving consumption of contaminated fish and vegetation.

The risk assessment (SERA 2007) found that following longer-term exposure to aminopyralid that had been applied at the maximum rate, the greatest potential risk was associated with long-term consumption of contaminated vegetation (not fruit), however the upper bound of risk was still well below levels of concern by a factor of about 12, The risk assessment also notes that long-term consumption of vegetation is a conservative assumption because many plants treated with the maximum amount of aminopyralid will likely show some signs of damage, lessening the chance that members of the public would consume the plants for a long period of time.

The public could be indirectly exposed to herbicide when they harvested and consumed fish, wildlife, or plants contaminated with herbicide. Risk associated with consumption of contaminated fruit and contaminated fish by the public following application of aminopyralid at the maximum rate were considerably below levels of concern, by factors of 100 to 125,000, respectively (SERA 2007).

As with chronic, longer-term exposures, none of the acute/accidental exposure scenarios involving aminopyralid exposure to the public exceeded levels of concern even when considering exposure to the maximum legal application rate (SERA 2007). Even the scenario involving a child drinking contaminated water following a large spill of herbicide into a small pond resulted in a hazard quotient below the level of concern (0.6 where levels of concern exceed 1.0).

Finally, we believe that through our proposed public outreach efforts and physical posting of application areas with warning signs, the CBJ public should experience even less potential for risk of herbicide exposure under Alternative 2 of this EA than is portrayed in the SERA and EPA risk scenarios.

Cumulative Effects of Alternative 2 to Public Safety and Health: Impacts to public and non-public safety and health are highly unlikely from the combined applications of an IPM approach allowing for herbicide use on all invasive species infestations over a period of years. This assessment includes consideration of cumulative direct and indirect effects associated with potential for exposure to residual herbicide. The two types of herbicide proposed for use have low toxicity and, consequently, the inherent level of health risk to public and non-public is minimal and readily mitigated through compliance with temporary site access restrictions, herbicide label stipulations, and agency standards for safe herbicide storage, transportation, use, and disposal.

Low volume, small-scale, and ground-based direct foliar applications of aminopyralid and glyphosate proposed for use under this alternative would pose insubstantial direct or indirect risk to public and non-public safety.

4.4 Conclusion

Consistent with legal requirements and Federal policies outlined above, we are required to prevent and minimize the impact of factors, such as invasive species, that can impinge upon the integrity, function, and productivity of natural evolutionary, ecosystem, and successional processes. While estimating the full ecological and economic impacts of invasive plant species is very difficult, initial estimates suggest that 5,000 species of invasive plants are present in natural or wild ecosystems in the U.S., for agriculture alone the total annual cost of introduced weeds to the US economy has been estimated at $26 billion, and the total estimated cost of damages and control efforts associated with introduced plants, animals and microbes in the US are more than $120 billion (Pimentel et al. 2005, Pimentel 2009). In the western United States, approximately 51 million hectares of rangeland are now dominated by invasive plants considered to be noxious weeds, or more than two-thirds of all western rangelands, with large negative impacts on the prevalence and diversity of native species (Eviner et al. 2010). These large-scale invasive plant invasions can affect ecosystem services include regulation of water flow, water quality, soil fertility, soil carbon storage, and wildlife habitat (Eviner et al. 2010).

We sufficiently understand the existing and potential adverse impacts associated with the invasive plant species present in the CBJ, recognize that management action is warranted, and have concluded that delay would not be prudent (Carlson et al. 2008, Lavergne and Molofsky 2004, Fierke and Kauffman 2006, Urgenson et al. 2009, Seefeldt and Conn, 2011). The successful management and ultimate eradication of invasive plants in the CBJ requires multiple components: 1) knowledge of where species occur and their potential threats to native species and ecosystems, 2) an IPM plan with clear goals, objectives and priorities, and 3) effective IPM plan implementation. IPM plans are critical components for a successful invasive plant management program in the CBJ.

Implementation of Alternative 1, which relies solely on cultural, manual and mechanical methods, would potentially eliminate small infestations of most moderately to extremely invasive plant species known to occur in the CBJ. Review of environmental consequences indicated that implementation of Alternative 1 would entail negligible safety and environmental risks in the short term. However, this strategy would inevitably fail due to the difficulty of control of large infestations of perennial invasive herbs and shrubs and limited availability of funding to simultaneously manage all existing and new incipient infestations using these methods. Under Alternative 1, we predict that invasive species would increase and eventually achieve a level of abundance that is unmanageable. Consequent ecological impacts would shift from negligible in the short-term to minor in the mid-term to moderate in the long-term in proportion to increases in the area dominated by invasive plant species and the corresponding decrease in the integrity and quality of native fish, wildlife, and plant habitat.

Alternative 2 would adopt an IPM approach. For many species this alternative would include the same cultural, manual and mechanical methods as are included under Alternative 1, but would allow for directed herbicide use in the appropriate situations. For example, mechanical control methods have proven ineffective for controlling some invasive plants, such as orange hawkweed, *Hieracium aurantiacum* in Alaska (Seefeldt and Conn 2011). This approach is consistent with the approach adopted by the Fish and Wildlife Service nationally and with all pertinent federal laws and policies. Small infestations consisting of 10 or fewer invasive plants per infestation area would be managed exclusively with manual and mechanical methods. Larger infestations would also be managed with these methods, potentially in conjunction with herbicide use.

Impacts associated with implementation of Alternative 2 would include minor short-term negative effects. Limited herbicide use under this alternative could potential harm non-target plant species within or adjacent to invasive plant infestations. However, potential negative impacts would decline to a negligible level within 10 years due to successful control of infestations and recovery of native plant communities at treated sites. This benefit would increase from minor to moderate through time in direct relationship to the area that could have been occupied by invasive species had the alternative not been implemented.

We believe that management using all available IPM tools and techniques offers a high degree of success in meeting these goals, despite the probability that IPM management efforts would need to continue, albeit at very low levels, to address newly documented infestations. Ongoing potential for discovery of invasive plant infestations in the CBJ is relatively high for two reasons: 1) Introductions of invasive plant species to the CBJ will likely continue, and 2) previously unknown infestations will be discovered as public awareness increases, and as efforts to systematically inventory invasive plant distributions within CBJ continue.

In considering Alternative 2, which we identify as the preferred alternative, we evaluated the human health and ecological effects associated with herbicide use. We conclude that any potential impacts would be minimized by use of aminopyralid and glyphosate which are relatively low toxicity herbicides, adherence to label restrictions concerning their application, and posting of signage in sprayed areas and community outreach regarding treatment efforts. These herbicides can facilitate control, in the appropriate situations, of many of the priority invasive plants that occur in the CBJ yet also are regarded as minimally detrimental to human health, biological resources, and ecosystem services. Additionally we would institute practices to further ensure safe herbicide use including a minimum threshold size of infestation (more than 10 plants per infestation area) and a prohibition on use of aminopyralid within 20 feet from water bodies (USNPS 2008). Proposals for site-specific application of herbicide would require landowner permission, additional systematic review and approval by the agency, and the approval of permitting authorities to ensure that the proposed use was appropriate, site environmental characteristics were evaluated, and safety standards were met.

5.0 Consultation and Coordination

We announced our intention to develop this EA, described the anticipated proposed action, and solicited input of interested parties in a scoping letter issued in March 16, 2011 (Appendix B). The letter was distributed to 35 parties (individuals, conservation organizations, CBJ, tribal organizations, etc.). A single response to the letter expressed concerns about the impact of invasive plant management actions on water resources, which we have addressed within this EA in Section 1.4.

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6.0 Appendices

Appendix A. Information on pesticide use proposals

U.S. Fish & Wildlife Service

Pesticide Use Proposals

One Step Toward Protecting Trust Resources

What are Pesticide Use Proposals?
A Pesticide Use Proposal (PUP) is information required by the U.S. Fish and Wildlife Service (Service) before application of a pesticide on Service property. It is a protective measure to ensure the proper use of pesticides on Service lands. The form asks for a variety of information including where the pesticide will be applied, what pesticide will be used, what species will be managed with the pesticide, and whether or not there are any endangered species in the pesticide application area.

What are the relevant authorities for PUPs?
Many authorities relate to pesticides and PUPs. Some of them include the Federal Insecticide, Fungicide, Rodenticide Act; Endangered Species Act; National Environmental Policy Act; Department of Interior, Pesticide Use Policy (517 DM 1); Service Pest Management Policy and Responsibilities (30 AM 12); and National Wildlife Refuge System Pest Control Policy (7 RM 14).

Who approves PUPs?
PUPs are usually approved by the Service Environmental Contaminant or National Wildlife Refuge staff at the field, regional, and national levels, depending on the pesticide being proposed for use.

With Rachel Carson as part of our legacy, pesticide use proposals are one critical step we can take to ensure proper pesticide use on Service lands. Pesticides play a role in resource management, but they must be used with proper precautions.

What benefits do the Service gain from PUPs?

Pesticide Use Proposals help ensure:

- Pesticides are used safely
- Pesticides are used effectively
- The lowest risk products are selected
- Pesticide label instructions are followed
- The best products are selected for the target pests
- Adequate pesticide application buffers are maintained
- Protection of groundwater and surface water
- Compliance with the Endangered Species Act and other applicable laws and regulations
- Reductions or eliminations of unnecessary pesticide use.

USFWS

In 1962 Rachel Carson wrote the bestselling book, Silent Spring, which warned about the dangers of pesticide use and misuse.

How many PUPs are submitted each year?
At the field and regional levels, over 1,000 PUPs are reviewed each year. In 2004, the Washington Office reviewed over 440 PUPs.

Why does the Service use pesticides?
The Service uses pesticides as one tool in an integrated pest management approach in managing pest species that interfere with resource management objectives. Most of the pesticides the Service uses are on National Wildlife Refuges for the management of non-native invasive species, such as Canada thistle (*Cirsium arvense*), johnson grass (*Sorghum halapense*), and phragmites (*Phragmites australis*). These species out compete the native species, which is detrimental for native ecosystems. Pesticides play a role in resource management, but they must be used wisely along with other measures to manage and/or eliminate pest species.

USFWS

Pesticide use proposals help ensure pesticide affects to non-target organisms, like these wood ducks, are eliminated.

Contact Information:

U.S. Fish & Wildlife Service
1 800/344 WILD
http://www.fws.gov

February 2005

Division of Environmental Quality
4401 N. Fairfax Drive, Room 322
Arlington, VA 22203
703/358 2148
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Appendix B. Scoping Letter Issued to Public

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Juneau Fish & Wildlife Field Office
3000 Vintage Blvd., Suite 201
Juneau, Alaska 99801-7100
(907) 780-1160

March 16, 2011

The Juneau Fish and Wildlife Field Office (Juneau Field Office) is preparing an Environmental Assessment regarding Juneau Field Office-sponsored management of invasive plants in the City and Borough of Juneau (CBJ). Invasive plants are plant species that are not native to ecosystems within the CBJ and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Due to their aggressive nature, some invasive plants have high potential for displacing native plants, disrupting ecosystem functions, and degrading fish and wildlife habitat. Left unchecked, invasive plants threaten the integrity and productivity of terrestrial and aquatic ecosystems important to fish, wildlife, humans, and the local economy.

Invasive plants in the City and Borough of Juneau

Invasive plants have infested a variety of public and private lands in the CBJ, especially in areas where native plant communities have been removed or disturbed by land development activities. These areas include road and utility right-of-ways, parking lots, yards, beaches, trail corridors, and riparian habitats. Several invasive plant species found in Juneau have invaded or are capable of invading relatively pristine or undisturbed habitats. To date, more than 30 species of invasive plants have been found in the CBJ and seven of these species have been classified as extremely invasive. Because most invasive species in the CBJ currently occur in relatively small numbers or at a few locations, early eradication efforts are necessary before these plants become more widely distributed and abundant.

Juneau Field Office Habitat Restoration Program

The Juneau Field Office works with a variety of partners to conserve, restore, and enhance fish and wildlife habitat through two Habitat Restoration and Conservation grant programs - the Partners for Fish and Wildlife Program and the Coastal Conservation Program. Using financial and technical assistance provided through these programs, Juneau Field Office will establish voluntary and cooperative partnerships with landowners, organizations, agencies and other entities to manage invasive plant infestations in the CBJ.

Appendix B. (continued)

The Juneau Field Office considers invasive plants to be a serious threat to the conservation and protection of federal trust resources and their habitats in the CBJ. In 2010, Juneau Field Office joined the Juneau Cooperative Weed Management Area (Weed Management Area), a partnership of citizens and representatives from non-profit, municipal, state, federal, and tribal organizations. The Weed Management Area published a 5-year invasive plant management plan in 2010. The plan establishes goals and strategies for management of the top 10 invasive plant species found in the CBJ. Juneau Field Office is helping to implement the plan's strategies by providing technical assistance to the Weed Management Area and participating in invasive plant education and management events. A copy of the plan can be found at www.juneauinvasives.org.

Invasive Plant Control in the CBJ

The Juneau Field Office will utilize an Integrated Pest Management (IPM) approach to address the invasive plant problem. IPM is a systematic planning, evaluation, and decision-making process used to guide and direct management of pests such as invasive plant species. Specifically, the IPM approach requires evaluation of:

- pest biology
- infestation characteristics
- environmental factors, and
- reported effectiveness and environmental impact of various methods of pest management

Methods under consideration for managing invasive plant infestations in the CBJ include:

- public education (e.g., preventing introduction and spread)
- manual control (e.g., hand-pulling and cutting), and
- chemical control (e.g., herbicides).

Environmental Assessments

The National Environmental Policy Act requires all federal government agencies to address the environmental effects of proposed federal agency actions. Juneau Field Office is conducting an Environmental Assessment to determine the significance of the environmental impact of invasive plant management in the CBJ. An Environmental Assessment is a concise public document that provides sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or a Finding of No Significant Impact. The Environmental Assessment will describe the purpose and need for invasive plant management, detail management options (alternatives), evaluate the environmental consequences of undertaking those options, and provide an opportunity for public involvement. The end result of the Environmental Assessment will be: 1) a decision on which management option best meets Juneau Field Office objectives for invasive plant management in the CBJ while minimizing environmental impact or 2) a decision to prepare an Environmental Impact Statement. The geographic scope of this Environmental Assessment includes private, municipal, state, and federal lands within the official CBJ boundary. Within this boundary invasive plants occur primarily along and within a few hundred feet of the road system.

The outcome of the Environmental Assessment process is a decision on the method, or combination of methods, which will be applied to manage a particular invasive plant species or infestation. Manual control methods under consideration include hand-pulling and cutting, mowing, burning, and tarping. Chemical control methods under consideration include use of low-toxicity glyphosate- and aminopyralid-based herbicides. Herbicide application methods, if selected, will be limited to low-volume spraying (e.g., backpack sprayers), injection into plant stems, and/or wiping plant parts. If selected, the herbicide application(s) may be combined with other control methods to improve efficacy. The type of control methods used will depend on land ownership, environmental factors, and the specific species and infestation to be treated. Invasive plant management actions supported by the Juneau Field Office within the CBJ will be undertaken only with the consent of the landowner and approval of permitting authorities, when such permits are required by State and/or Federal law. Herbicides, if used, will be applied by or under the direction of state-certified pesticide applicators and all label and other regulatory requirements will be strictly followed, including any public notification requirements and any post-application site access restrictions. Additionally, invasive plant management projects that use herbicides will only occur after a Pesticide Use Proposal and IPM Plan are evaluated and approved by the U.S. Fish and Wildlife Service's Alaska Regional Office.

The first stage of the Environmental Assessment process is to request public input on the scope of the assessment. Please take a moment to consider the threat of invasive plants and how that threat should be best managed in the CBJ. If you have specific comments regarding invasive plant management in the CBJ, please include them in your response to this letter. Your comments will be considered in the preparation of the Environmental Assessment. Comments may be submitted by April 1, 2011 to the address above or emailed to the Juneau Field Office at juneau@fws.gov. For additional information on this project, please contact John Hudson (john_hudson@fws.gov; 907-780-1169).

Sincerely,

Bill Hanson
Field Supervisor

Appendix C. Scoping Comment Letter

DIVISION OF WATER
WATER QUALITY STANDARDS, ASSESSMENT & RESTORATION PROGRAM

410 Willoughby Ave., Ste 303
P.O. Box 111800
Juneau, AK 99811-1800
PHONE: (907) 465-5300
FAX: (907) 465-5274
http://www.dec.alaska.gov

March 21, 2011

Bill Hanson
Field Supervisor
Fish and Wildlife Service
Juneau Field Office
3000 Vintage Blvd., Suite 201
Juneau, Alaska 99801-7100

Dear Mr. Hanson:

The Alaska Department of Environmental Conservation Division of Water (DOW) thanks you for the opportunity to comment on the proposed Environmental Assessment for Invasive Weed Management in the City and Borough of Juneau (3-16-2011).

Clean Water Act (33 U.S.C. 1251 - 1375)

A noxious weed control activity which results in the deposition of fill into aquatic areas with federal jurisdiction (Waters of the U.S.) requires consultation with the U.S. Corps of Army Engineers (USCOE). The USCOE may require a permit under Sections 404 of the Clean Water Act and Section 401 Water Quality Certification (administered by the Alaska Department of Environmental Conservation).

Section 402 of the Clean Water Act defines the National Pollution Discharge Elimination Scheme (NPDES), administered by the EPA. The NPDES requires anyone who wants to discharge pollutants (including herbicides), into aquatic areas with federal jurisdiction, to first obtain an NPDES permit, or that discharge will be considered illegal. The CWA allows the EPA to delegate the NPDES Permit Program to state governments, enabling states to perform many of the permitting, administrative, and enforcement aspects of the program. The Alaska Department of Environmental Conservation administers NPDES permits for use of herbicides to control aquatic noxious weeds in Alaska.

These permits are also subject to review through the Alaska Coastal Management Program and completion of a Coastal Project Questionnaire.

Appendix C. (continued)

The Department also regulates the use of pesticides and herbicides through Title 18, Chapter 90, Section 525 of the Alaska Administrative Code (18 AAC 90.525). The Alaska Pesticide Management Plan to Protect and Restore Water Quality (2007) serves as background and guidance to regulate the use of pesticides and herbicides and protection of state water resources. The Department encourages USFWS to review this document and work with staff from the Division of Environmental Health, Division of Water, and other agency stakeholders in the development of the Environmental Assessment to ensure the protection of water resources are adequately addressed.

Invasive species dispersal has been directly linked to the degradation of ecosystem services within watersheds. The EPA Watershed Academy notes that;

"Invasive species effects on water resources can be direct, as in the case of many aquatic nuisance species, or indirect, as in terrestrial species that change water tables, runoff dynamics, fire frequency, and other watershed attributes that in turn can alter water body condition. Beyond the dramatic estimate of $138 billion for yearly economic impacts and control costs, impacts to ecosystems and their beneficial services are estimated to be several times more than this total."

The City and Borough currently has four waters listed as "impaired" and have been assigned Total Maximum Daily Loads (TMDLs) through the State 303(d) listing process. These waterbodies are likely to be significant vectors for invasive dispersal as well as the introduction of aquatic nuisance species considering they are already stressed by anthropogenic activities.

The Department encourages USFWS to consider Best Management Practices (BMPs) in riparian areas and disturbed areas that may be used to bolster the resiliency of local waters. The City and Borough of Juneau has been a leader in the use of BMPs in the management and control of stormwater- a common source of stressors such as nutrients and sediment. The Department also asks that USFWS note the potential effects on water resources that may result from physical, chemical, or biologic controls of invasive species. While it is valuable to work towards the eradication of invasive species, mud on vehicles has been noted to be a vector of distribution and considered as USFWS staff develops guidance documents.

Sincerely,

Brock Tabor
Environmental Program Specialist III